Installation and Service Manual

Models: GWC09AA - K5NNA6A

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Abbreviations used within this manual:

Abbreviation	Clear Words
AC	Air– conditioning
HC	Hydrocarbon
LFL	Lower flammability level
OFDN	Oxygen free and dry nitrogen
PCB	Printed Circuit Board
PG motor	Indoor unit fan motor
PPE	Personnel protective equipment
RAC	Refrigeration and air– conditioning
UFL	Upper flammability level

INTRODUCTION

ATTENTION

Please read this manual carefully before installing and operating the GREE Hydrocarbon Air– Conditioner unit.

Careless installation and operation can cause severe injuries to operators, workers and damage to the air-conditioner unit itself.

Keep this manual in a location for easy access as it is needed for reference during installation, maintenance, service and operation of the unit.

This manual does not cover all aspects of installation, maintenance and service of the chiller units; if additional information is needed, contact the GREE Costumer Service or Sales Office.

General Information

Warning and cautions appear at appropriate locations throughout this manual book.

General Safety Instructions

Please pay careful attention to these safety instructions, to avoid risks to people and property. Before starting work on maintenance read this manual thoroughly and pay particular attention to the relevant chapters.

Regardless of further requirements of the country in which the equipment will be installed: assembly, first start up, technical service, maintenance and repair, as well as dismantling and disposal have to be carried out by authorised personnel only.

During every operation strictly follow the instructions within this manual. Pay attention to the specific rules of air conditioning, electrics and refrigerant handling of the country within which the equipment is installed.

Key sections and/or sentences are highlighted with specific icons and symbols to the right side of the page. Please pay particular attention to this information.

The symbols used in this manual are as follows:

This is a specific remark and points out the importance of a specific section

Information window highlighting important content of the specific section or additional information to consider.

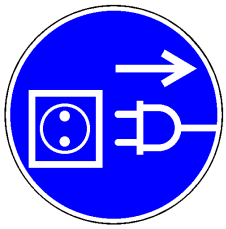
This sign will indicate that you are handling a flammable substance and the surrounding environment can possibly contain it.

This is a general warning sign.

This label is used to indicate that the flammable refrigerant is present within the application and service equipment

Images that indicate something that you should be strictly avoided

Specific bans!



Specific commandments!

Instructions for first aid!

Fire protection!

Carefully read the instructions

Working on components with safety-relevant functions jeopardises the safe operation of the installation. In case it is necessary to replace components, only use approved parts from GREE Electric, the Original Equipment Manufacturer (OEM) or Gree released or authorised components. The system contains the refrigerant R-290 (propane). This condition requires special safety precautions to be observed. While working on the system, the presence of any kind of ignition sources (e.g. sparks, open flames, hot surfaces, static electricity) are strictly prohibited. At the installation site, no matter what kind of activities are executed, smoking is strictly prohibited!

ONLY original GREE (OEM) spare-parts are permitted for Service and Repair!

Likewise, ensure the installation site is well ventilated. For further details on the handling of the refrigerant R-290 see also pages 11 and 41.

Do not charge the system with any refrigerant which is not R-290! Do not mix any refrigerants! Before filling the system, ensure that there is no air (or other non-condensable gases such as nitrogen) left in the system, otherwise there is severe danger of damage to the system caused by excessive high pressure.

After charging the system with refrigerant, carefully examine and confirm the tightness by the use of an appropriate electronic leak detector!

Electrical operations:

Proceed according the manuals instructions!

Electric operations (installation, repair, modification, maintenance, adjustment) have to be fulfilled by trained and authorised personnel only.
When dealing with electrical issues, the specific rules of the country within which the equipment is installed must be followed, in addition to the instructions within this manual.
When working on the equipment or parts of it, the system has to be de-energised (by master switch, circuit breaker or separate cut-out) and made safe against restart of the system. Do not reconnect the system to the electric circuit until all work is done and all connections are tested.
If handled unsafely or unprofessionally, severe electric shocks can occur. Consider the wiring diagram and follow the instructions of this manual very carefully whilst working on electrical parts. Wrong connections or incorrect grounding may lead to severe injuries and mortal danger.

Ground the system according to the particular requirements of the country within which the equipment is installed.

Connect all the wires properly and durably. Loose cables may lead to overheating or fire.

Installation site:

Regard neighbour protection, avoid disruptive noise emissions!

Ensure that the ceiling or the wall is solid enough to carry the weight of the system which will be mounted on it. Pay attention to the installation of the outdoor unit: operating noise and air flow should not bother neighbours.
Make sure that appropriate measures are taken against noise emissions, especially when the system is to be installed close to sensitive facilities (such as hospitals).

Avoid condensation of humidity at tubes and drains!

Insulate all tube connections professionally to avoid formation of water condensation and water damage to the rooms.
The outdoor unit must be fixed to a flat, stable location. Thereby pay attention that in that location there is no snow, foliage or dirt accumulating. Take care of further requirements to prevent the system from damage by earthquakes, hurricanes or high winds.

Pay attention to movable parts!

Do not touch movable parts and keep free from clothing. Do not touch any part of the system without wearing suitable personnel protective equipment and clothing in order to avoid injury from: the compressor (hot surface), the refrigerant condenser (hot surface, sharp fins) and the refrigeration tubes (hot and cold surfaces, sharp spots).

Wear suitable protective clothing!

Suitable personnel protective equipment is at a minimum:

1. Goggles
2. Gloves
3. Shoes
4. Overalls

Do not install the system in humid places.

Do not clean the system using water.

Do not energise the system without the suitable air filter assembly to prevent dust accumulation within itself.

Clean up the installation or service area once work is completed and ensure that no waste metal parts or wires remain in the equipment housing.

If anything irregular or conspicuous occurs (such as burnt part, smell, loud noise, etc.) disconnect the system immediately and isolate from the electrical supply.

Having a malfunction while commissioning, immediately disconnect the system from mains!

Pay attention to the room size for indoor unit installation!

For specific information refer page 56 of this manual.

Minimum room size

HC R-290 is a flammable refrigerant and can form explosive mixtures in low concentrations. To minimise the risk of fire or explosion, the system must be installed in a room with a minimum floor area.

Minimum requirements for service personal qualification

Unless there are further requirements, standards and legislation of the country within which the equipment is installed may apply. Any technicians that works on GREE hydrocarbon air–conditioners must be competent in the safe handling of flammable refrigerants, in addition to being in possession of knowledge and skills to maintain best refrigeration installation and servicing practices!

Get your Best Practices knowledge and skills updated for HC refrigerants and be certificated for these jobs!

There are already training activities in place for engineers, technicians and sales staff to provide professional knowledge and skills for the handling of HC refrigerants and refrigeration systems operating with HCs.

Get trained and have your

"HC Refrigeration Professional" certification!

Basics in RAC

Knowledge of the basic SI standard units for temperature, pressure, mass, density, energy.

Understanding of the basic theory of refrigeration systems including the functions of the main components in the system (compressor, evaporator, condenser, thermostatic expansion valves).
Understanding how to read a refrigerant flow chart and an electrical circuit diagram.
The determination of non-condensable gases in the refrigeration system and how to eliminate them.
The importance of the use of oxygen free dry nitrogen (OFDN) for system flushing, leak test and strength test.
The elimination of humidity from the refrigeration system and how to recover or vent HC refrigerant from a system.

Usage of tables and diagrams (log p/h diagram, saturation tables of a refrigerant, diagram of a single compression refrigeration cycle) and interpretation of these tables and diagrams.

Knowledge of the basic operation of the following components in a refrigeration system and their role and importance for refrigerant leakage prevention and identification:

- Temperature and pressure controls
- Sight class and moisture indicators
- Defrost controls, reverse cycle operation
- System protectors
- Measuring devices such as the pressure gauge manifold
- Thermometer
- Leak detector
- Refrigerant charging devices
- Vacuum pump
- Oxygen free dry nitrogen cylinder and pressure regulator

Fault finding – analysis and repair.

- Knowledge of flammable refrigerants
- Risk analysis for the application of flammable refrigerant and properties of flammable refrigerants
- Electrical circuit assessment and repair

Read More!
SAFETY CODE OF PRACTICE FOR REFRIGERATING SYSTEMS *UTILISING A2 & A3 REFRIGERANTS*

ISBN
1 872719 15 5

Checks before putting in operation, after a long period of non-use, after maintenance or repair intervention or during operation

Carry out a pressure and leak test to check the strength and the tightness of the system.
Usage of a vacuum pump.
Evacuation of the system to remove air and moisture according to standard practice.

Checks for leakage

Knowledge of potential leakage points of refrigeration, air-conditioning and heat pump equipment. Making a visual and manual inspection of the whole system.

Carry out a check for leakage of the system using an indirect method and/or one of the direct methods.

Direct leak detection methods

1. Fixed leakage detection systems
2. Portable electronic gas detectors
3. Ultraviolet (UV) indication fluids
4. Weak soapy water solution (bubble test) also in combination with OFDN
5. New installation tightness test for leakage detection procedure e.g. H_2/N_2
6. Operational system tightness test for leakage detection procedure

Indirect refrigerant detection methods:

1. Visual
2. Manual checks

Use of portable measuring devices such as pressure gauges, thermometers and multi-meters for measuring Volt/Amp/Ohm in the context of indirect methods for leakage checking and interpretation of the measured parameters.
It is very important to make use of an electronic gas detection device. Take care that the electronic gas detector is designed and certificated for the use with flammable refrigerants. Additionally, the electronic HC gas detector must be part of the Personnel Protective Equipment (PPE) of the technician because if this device is operational in the work area it will warn by detection and signalling if HC refrigerant is in the atmosphere.

The use of OFDN is important and the HC gas detector is indeed a personnel protection device (PPE)!

Handling of the refrigerant during installation, maintenance, servicing or, recovery or venting

Use scales to weigh refrigerant. Knowledge of the requirements and procedures for handling, storage and transportation, especially of flammable refrigerants and especially of contaminated refrigerant and oils. Safe HC refrigerant recovery and venting.

Installation, commissioning and maintenance of a compressor

The basic functioning of a compressor (including capacity control and lubricating system) and risks of refrigerant leakage to its operation.
Installing a compressor properly, including control and safety equipment.
Adjusting the safety and control switches. Checking the oil return system.
Start up and shut down a compressor and checking the good working conditions of the compressor, including by making measurements during operation of compressor.

Installation, commissioning and maintenance of condensers

The basic functioning of a condenser.
Installing a condenser properly, including control and safety equipment.
Adjusting the safety and control switches. Checking the hot-gas and liquid lines in correct positions. Start up and shut down a condenser and check the good working conditions, including by making measurements during operation.
Checking the surface of the condenser. Methods for condenser surface cleaning and fins adjustments.

Installation, commissioning and maintenance of evaporators

Preventive maintenance will improve the system efficiency

The basic functioning of an evaporator (including defrosting system).
Installation of an evaporator including control and safety equipment.
Adjusting the safety and control switches.
Checking the liquid and suction pipelines in the correct position and checking the hot gas defrost pipeline. Start up and shut down an evaporator and check the good working of the evaporator, including by making measurements during operation. Functional checking of the reverse cycling control device.
Checking the surface of the evaporator. Methods for evaporator surface cleaning and fins adjustments.

Piping

Regular professional brazing experience is an important precondition for the work with hydrocarbon refrigerants!

Professional brazing is another key component for safe and state-of-the-art HC system installation and servicing. Brazing leak-free joints on metallic tubes and pipes that can be used in refrigeration, air-conditioning or heat pump systems.
Make/check pipe and component supports and vibration elimination. Knowledge about the designing and dimensioning of the different refrigeration system section pipes including risers. The behaviour of lubricants within the refrigeration system and the influences of the dimensioning of pipe work in relation to lubricants. Develop strategies to minimise mechanical connections like flaring or flanges and to provide a sealed (hermetic) system.

Description of the system and its components

Unit Specifications GWC09AA—K5NNA4A

General Technical Specifications

Split-type On/Off

Item No	Parameter		Unit	Value
1	Model			**GWC09AA-K5NNA4A**
2	Product Code			CA115012800
3	Power Sup-ply	Rated Voltage	V～	220-240
		Rated Frequency	Hz	50
		Phases		1
4	Power Supply Mode			Indoor
5	Cooling Capacity		W	2650
6	Heating Capacity		W	NA
7	Cooling Power Input		W	883
8	Heating Power Input		W	NA
9	Cooling Power Current		A	3.92
10	Heating Power Current		A	NA
11	Rated Input		W	995
12	Rated Current		A	4.41
13	Air Flow Volume(SH/H/M/L/SL)		m^3/h	480/460/420/380/-
14	Dehumidifying Volume		L/h	0,8
15	EER		W/W	3,0
16	COP		W/W	NA
17	SEER		W/W	NA
18	HSPF		W/W	NA
19	Application Area		m^2	12-18

Indoor Unit

Item No	Parameter		Unit	Value
20	Indoor Unit	Model of indoor unit		GWC09AA-K5NNA4A/I
21		Fan Type		Cross-flow
22		Diameter Length(D x L)	mm	Ø 85x615
23		Fan Motor Cooling Speed (SH/H/M/L/SL)	r/min	1350/1150/1050/950/-
24		Fan Motor Heating Speed (SH/H/ML/SL)	r/min	NA
25		Output of Fan Motor	W	10
26		Fan Motor RLA	A	0.10
27		Fan Motor Capacitor	μF	1
28		Input of Heater	W	NA
29		Evaporator Form		Aluminium Fin-copper Tube
30		Pipe Diameter	mm	Ø 7
31		Row-fin Gap	mm	2-1.6
32		Coil Length (LXDXW)	mm	603X264X25.4
33		Swing Motor Model		MP28VB
34		Output of Swing Motor	W	2
35		Fuse	A	PCB 3.15A Transformer 0.2A
36		Sound Pressure Level (SH/H/M/L)	dB (A)	38/36/33/30
37		Sound Power Level (SH/H/M/L)	dB (A)	48/46/43/40
38		Dimension (WXHXD)	mm	815×165×267
39		Dimension of Carton Box (L/W/H)	mm	975×320×385
40		Dimension of Package(L/W/H)	mm	978X323X400
41		Net Weight	kg	14
42		Gross Weight	kg	18

Outdoor Unit

Item No	Parameter		Unit	Value
43	Outdoor Unit	Model of Outdoor Unit		GWC09AA-K5NNA4A/O
44		Compressor Manufacturer/Trademark		ZHUHAI LANDA COMPRES-SOR CO,LTD/GREE
45		Compressor Model		QXD-C184A030A
46		Compressor Oil		CP2922HT(EXP3535)
47		Compressor Type		Rotary
48		L.R.A.	A	21.00
49		Compressor RLA	A	3.90
50		Compressor Power Input	W	820
51		Overload Protector		Internal
52		Throttling Method		Capillary
53		Operation Temp	℃	16ºC～30ºC
54		Ambient Temp (Cooling)	℃	18ºC～43ºC
56		Condenser Form		Aluminium Fin-copper Tube
57		Pipe Diameter	mm	Ø5
58		Rows-fin Gap	mm	1-1.3
59		Coil Length (LXDXW)	mm	741×495.3×12.7
60		Fan Motor Speed	rpm	860±20
61		Output of Fan Motor	W	25
62		Fan Motor RLA	A	0,45
63		Fan Motor Capacitor	μF	2.5
64		Air Flow Volume of Outdoor Unit	m^3/h	1800
65		Fan Type		Axial-flow
66		Fan Diameter	mm	Ø400

Item No	Parameter		Unit	Value
68	Outdoor Unit	Climate Type		T1
69		Isolation		I
70		Moisture Protection		IP24
71		Permissible Excessive Operating Pressure for the Discharge Side	MPa	2.5
72		Permissible Excessive Operating Pressure for the Suction Side	MPa	0.5
73		Sound Pressure Level (H/M/L)	dB (A)	50
74		Sound Power Level (H/M/L)	dB (A)	60
75		Dimension (WXHXD)	mm	848X540X320
76		Dimension of Carton Box (L/W/H)	mm	878X360X580
77		Dimension of Package (L/W/H)	mm	881X363X595
78		Net Weight	kg	35
79		Gross Weight	kg	39
80		Refrigerant		R-290
81		Refrigerant Charge	kg	0.20
82	Connection Pipe	Length	m	5
83		Gas Additional Charge	g/m	Not Permitted
84		Outer Diameter Liquid Pipe	mm	Ø 6
85		Outer Diameter Gas Pipe	mm	Ø12
86		Max Distance Height	m	4
87		Max Distance Length	m	5
88	Container Loading Quantity	20'GP	set	95
89		40' GP	set	198
90		40' HQ	set	225

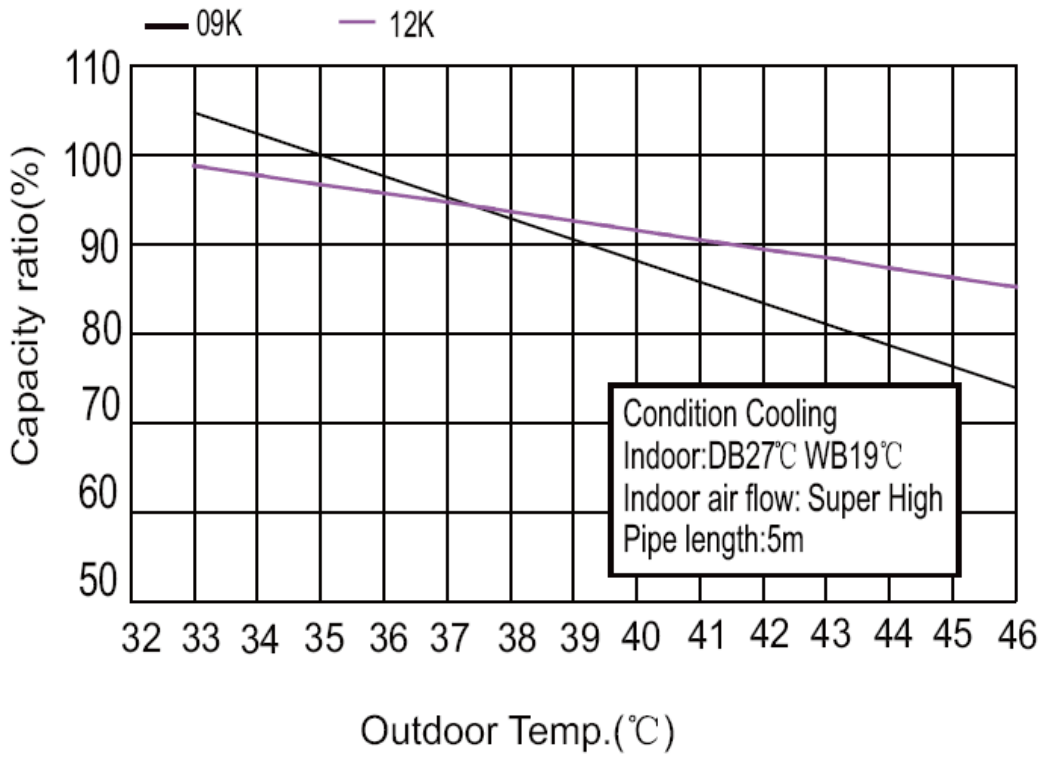
The unit is an INTRINSIC SAFE System! Refrigerant charge is limited to 200 gram

Top-up of charge is not permitted

Modification of system and in specific the pre-assembled pipe-length is not permitted!

Capacity Variation Ratio According to Temperature

Cooling Mode Only



Operation Data

Temperature Conditions in ℃		Model Name	Standard Pressure	Heat Exchanger Pipe Temperature		Indoor Fan Mode	Outdoor Fan Mode
Indoor	Outdoor	9K	P (MPa)	T1 (℃)	T2 (℃)	Super High	860
27/19	35/24		0.5 to 0.6	8 to 11	83 to 38		

Notes:

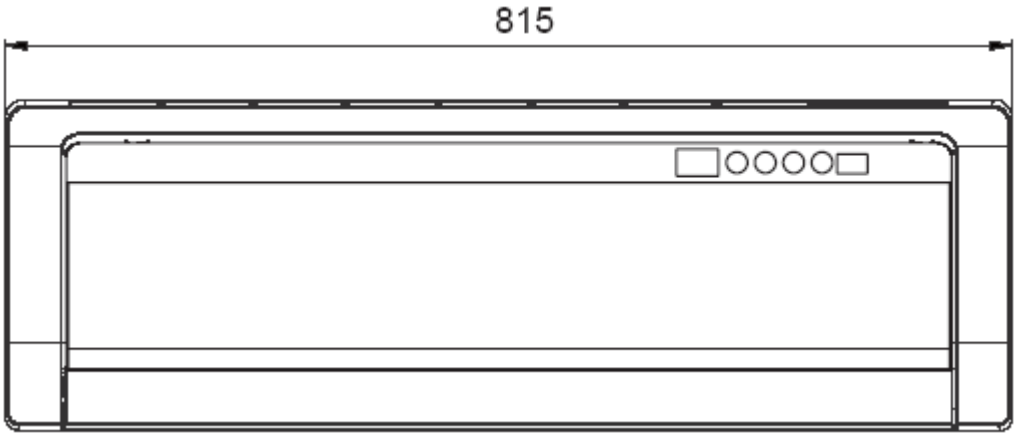
1. Measure surface temperature of heat exchanger pipe around centre of heat exchanger path (U-Bend) (Thermistor Thermometer)
2. Connection piping conditions (Liquid / Suction) fixed at 5 m
3. P = Suction - Pressure of refrigerant measured at service port connection
4. T1 = Inlet and Outlet Temperature of evaporator (pipe surface Temperature)
5. T2 = Inlet and Outlet Temperature of condenser (pipe surface Temperature)

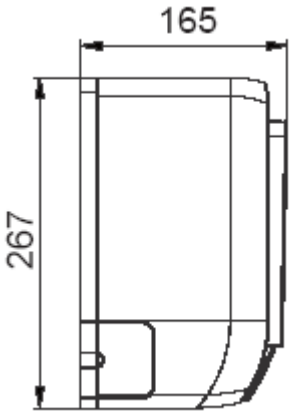
Modification of pipe-length is not permitted!

Construction Views

(All Dimensions in mm)

Indoor Unit





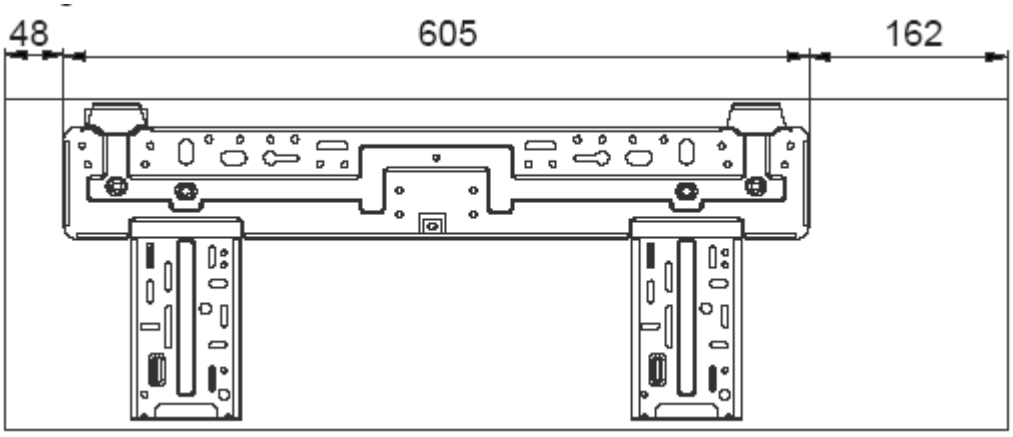
The indoor unit is equipped with pre-fixed and isolated refrigerant transfer pipes!

The length of the pipes is 5 m.

The indoor-unit is pre-charged with HC R-290 refrigerant

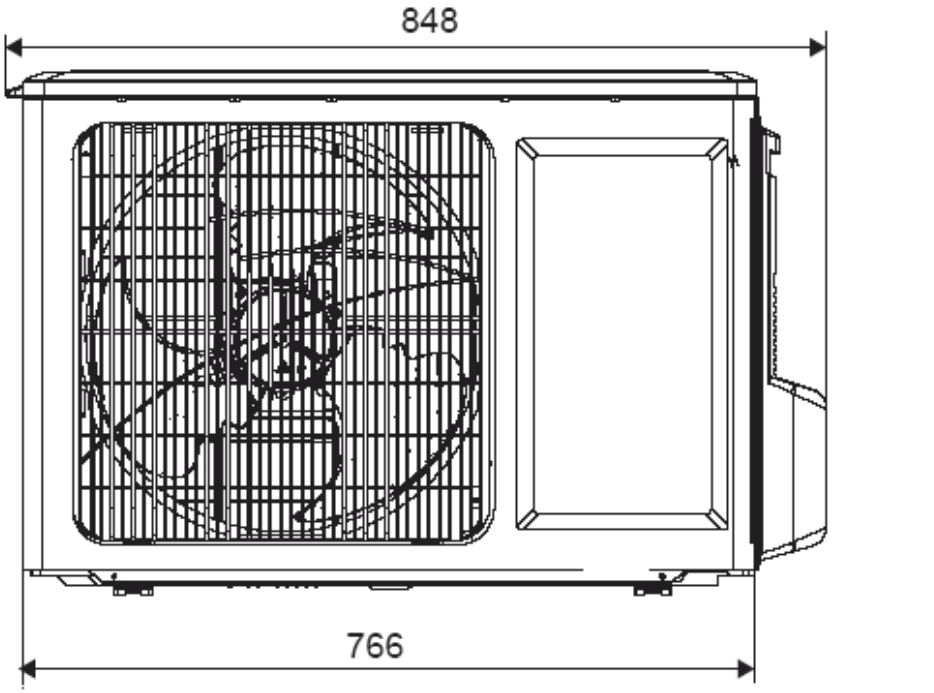
In addition pre-fixed is:

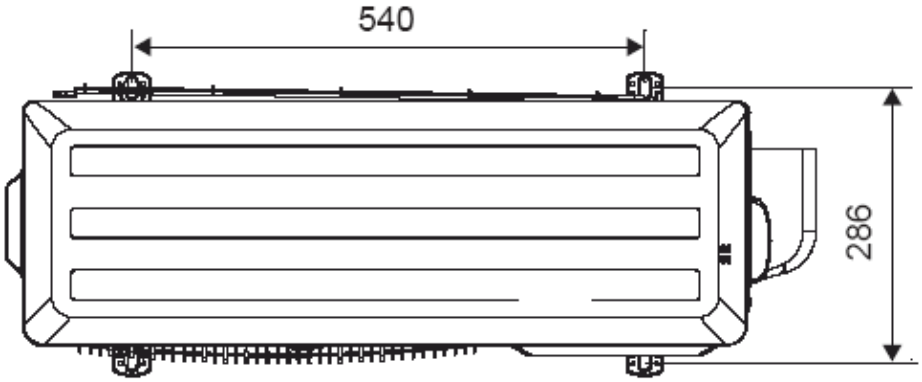
1. **Electrical connections between indoor and outdoor unit**
2. **Mains-supply cable with plug**
3. **Condensate drain pipe**

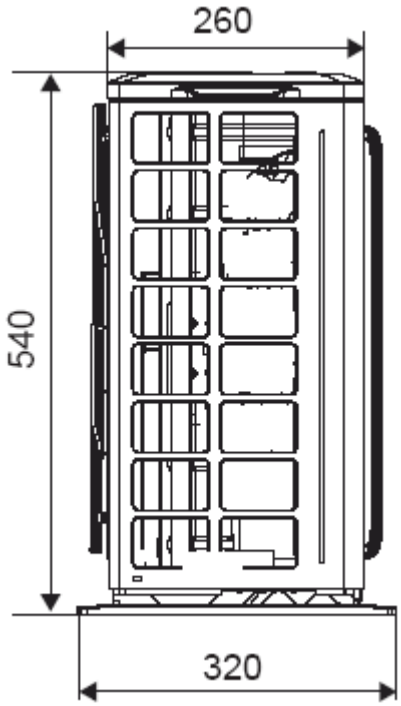


Wall Mounted Plate

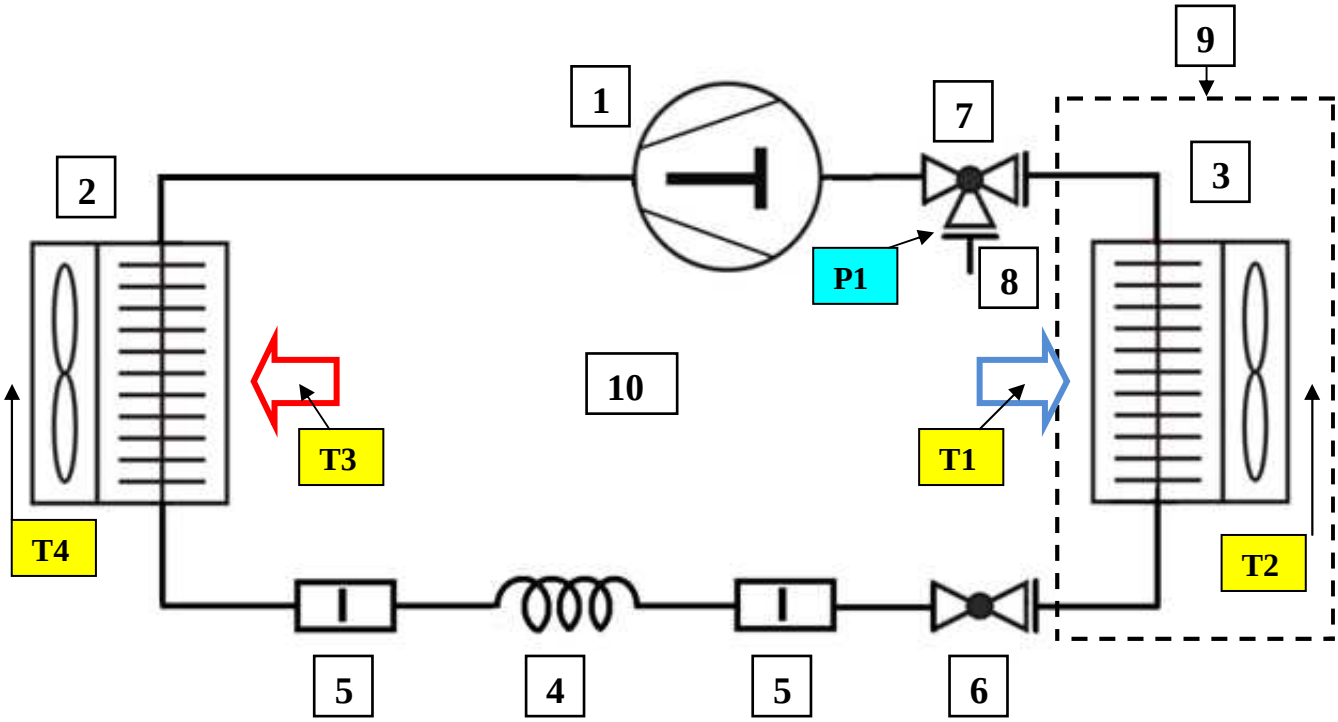
Outdoor Unit







Refrigerant Flow Diagram



	Designation	Remark
1	Compressor	Rotary scroll
2	Condenser	Finned Heat Exchanger
3	Evaporator	Finned Heat Exchanger
4	Capillary tube	Refrigerant expansion device
5	Strainer	Refrigerant filtering device
6	2 - way valve	Stop valve
7	3 – way valve	Stop valve and ¼” SAE service port
8	Service Port	1/4” NPT
9	Indoor unit	Pre-assembled with 5 m refrigerant transfer pipes
10	Outdoor unit	
P1	Suction pressure	R-290 low pressure gauge measuring
T1	Temperature Air- inlet	Room air entering evaporator
T2	Temperature Air- outlet	Room air leaving evaporator
T3	Temperature Air- inlet	Outside air entering the condenser
T4	Temperature Air- outlet	Outside air leaving the condenser

Schematic diagram

Do not modify electrical components or wiring, for replacements. Only use OEM spare-parts!

Electrical Data

Meaning of Marking

- **Indoor Unit**

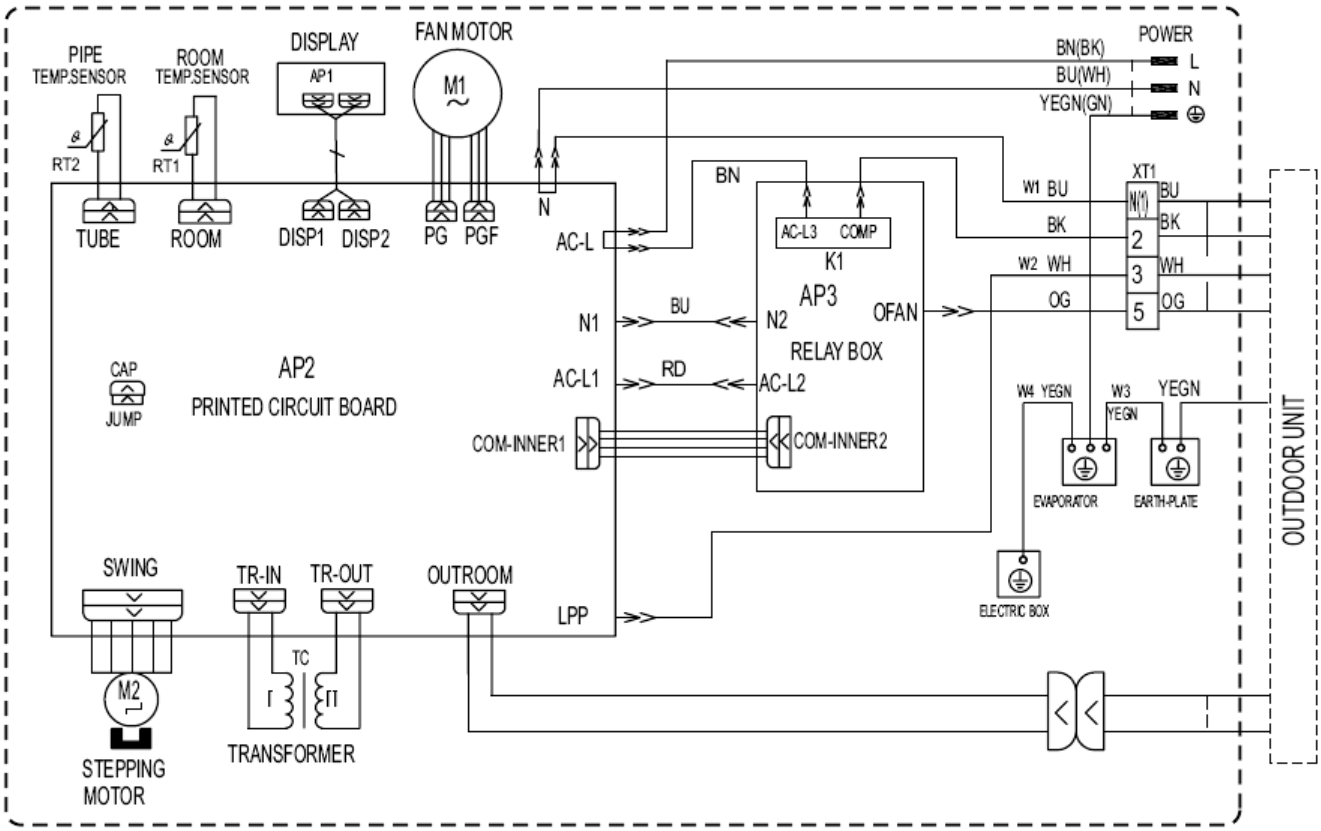
Symbol	Colour Symbol	Symbol	Colour of Symbol
BU	Blue	BN	Brown
YE	Yellow	WH	White
RD	Red	BK	Black
YEGN	Yellow / Green	⏚	Protective Earth

- **Outdoor Unit**

Symbol	Parts Name	Symbol	Colour Symbol	Symbol	Colour of Symbol
C1	CBB61	BN	Brown	WH	White
C2	CBB65	BU	Blue	YE	Yellow
SAT	Overload	BK	Black	RD	Red
COMP	Compressor	OG	Orange	YEGN	Yellow / Green
⏚	Protective Earth	GN	Green		

Electrical Wiring - Indoor Unit

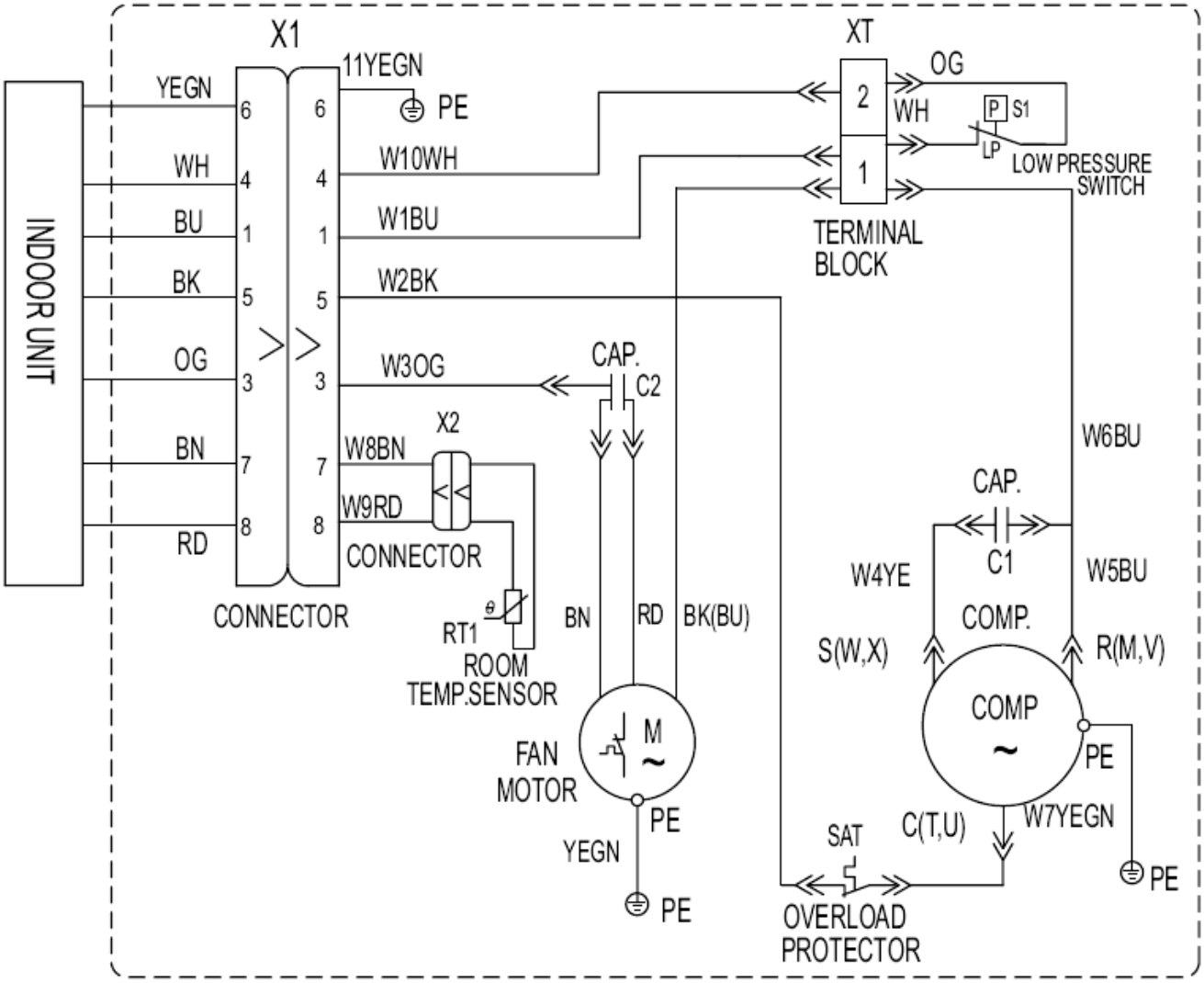
These circuit diagrams are subject to change without notice, please refer to the one supplied with the unit.



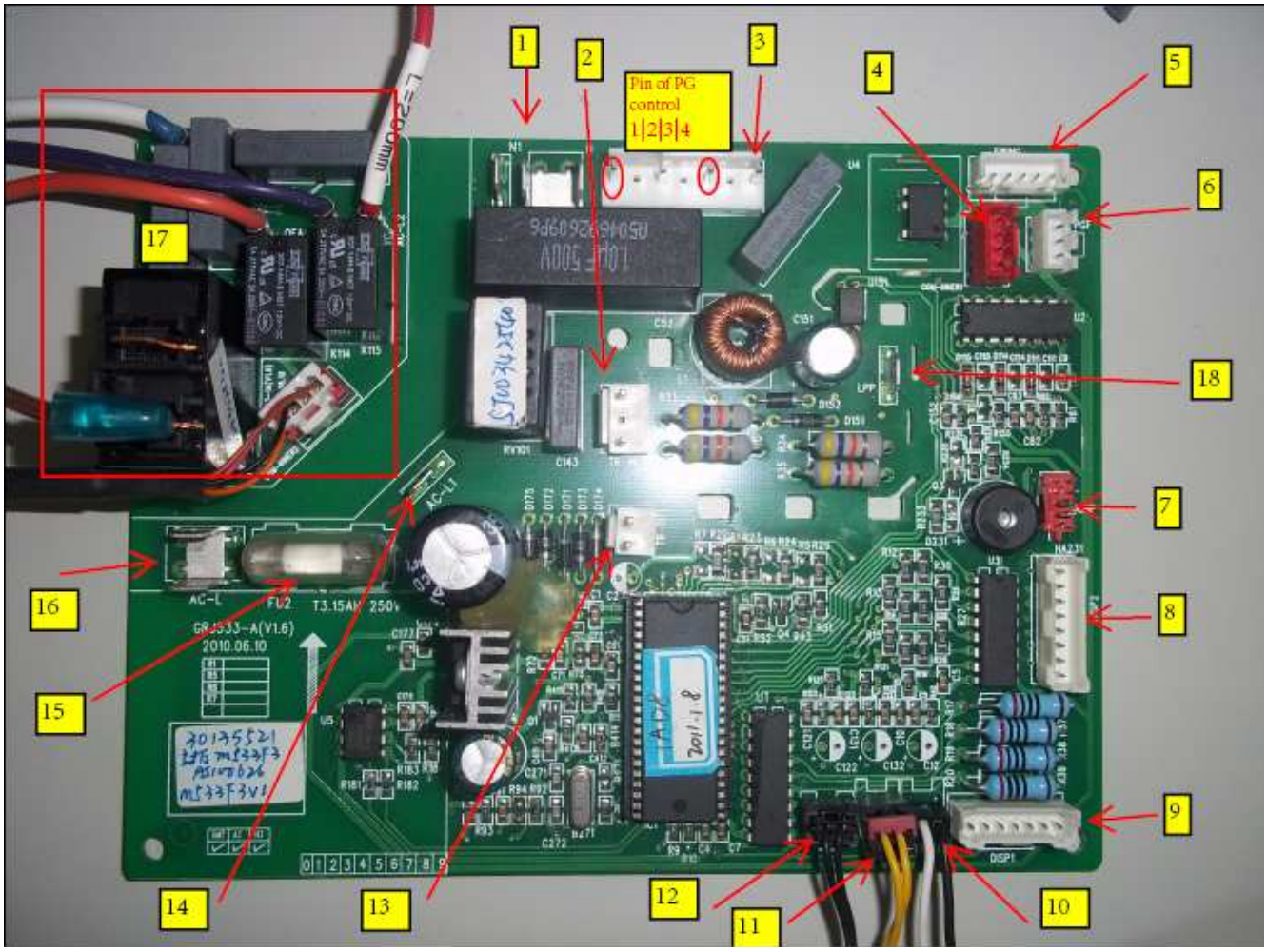
Electrical Wiring - Outdoor Unit

These circuit diagrams are subject to change without notice, please refer to the one supplied with the unit.

Do not modify electrical components or wiring, for replacements only use OEM spare-parts!



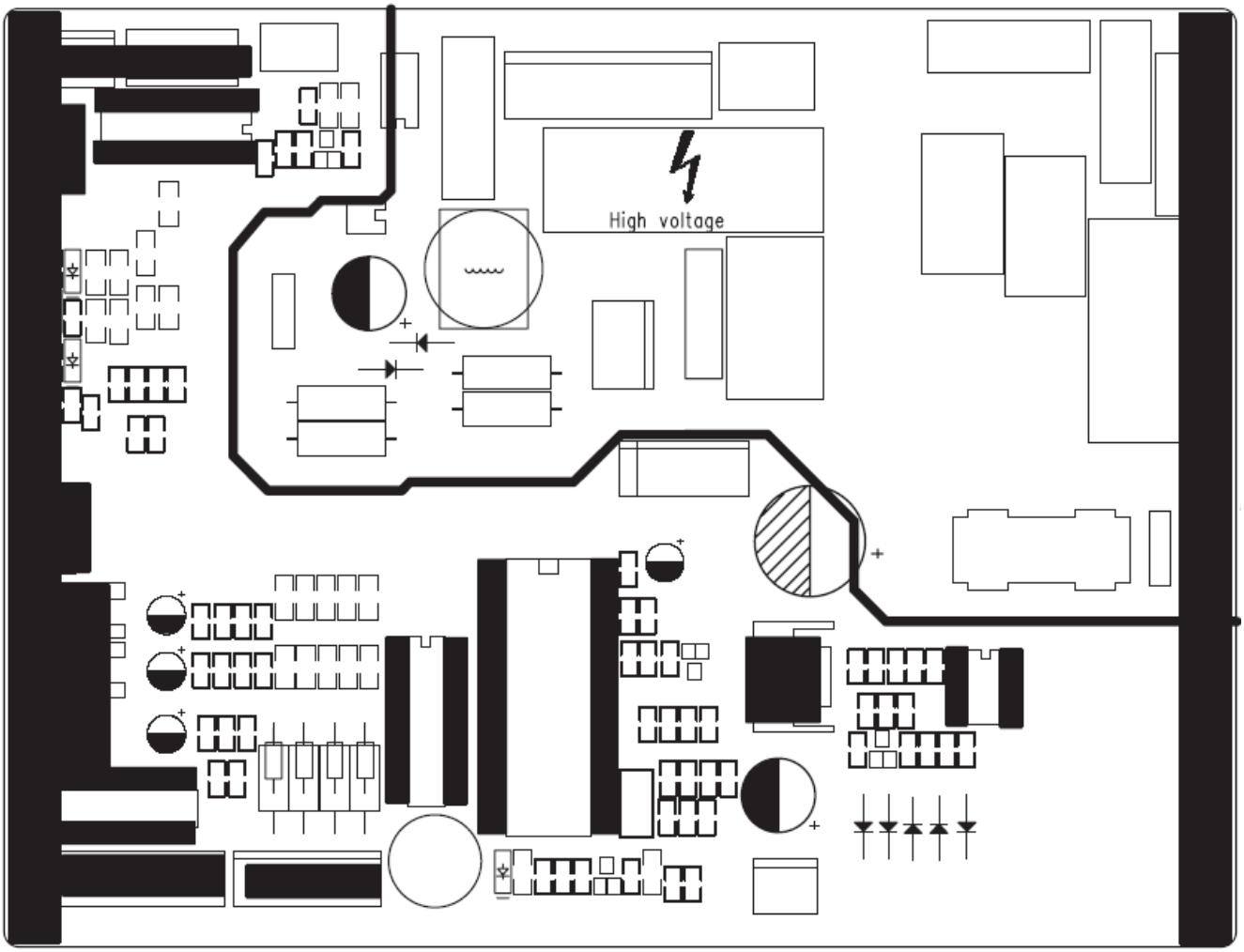
Printed Circuit Board (top-view)



No.	Name on PCB board	Interface Name	No.	Name on PCB board	Interface Name
1	N, N1	Neutral wire of PCB	10	OUTROOM	Outdoor ambient temperature sensor
2	TR-IN	Transformer input terminal	11	ROOM	Indoor ambient temperature sensor
3	PG	PG motor control	12	TUBE	Indoor tube temperature sensor
4	COM—INNER1	Relay box control	13	TR-OUT	Transformer output terminal
5	SWING	Swing motor control	14	AC-L1	Live wire input terminal of relay box
6	PGF	PG motor feedback	15	FU2	Fuse
7	JUMP	Jumper cap	16	AC_L	Live wire input
8	DISP2	Display connector 2	17	/	PCB indoor unit relay box
9	DISP1	Display connector 1	18	LPP	Low pressure switch

Printed Circuit Board (bottom-view)

Right Up Left

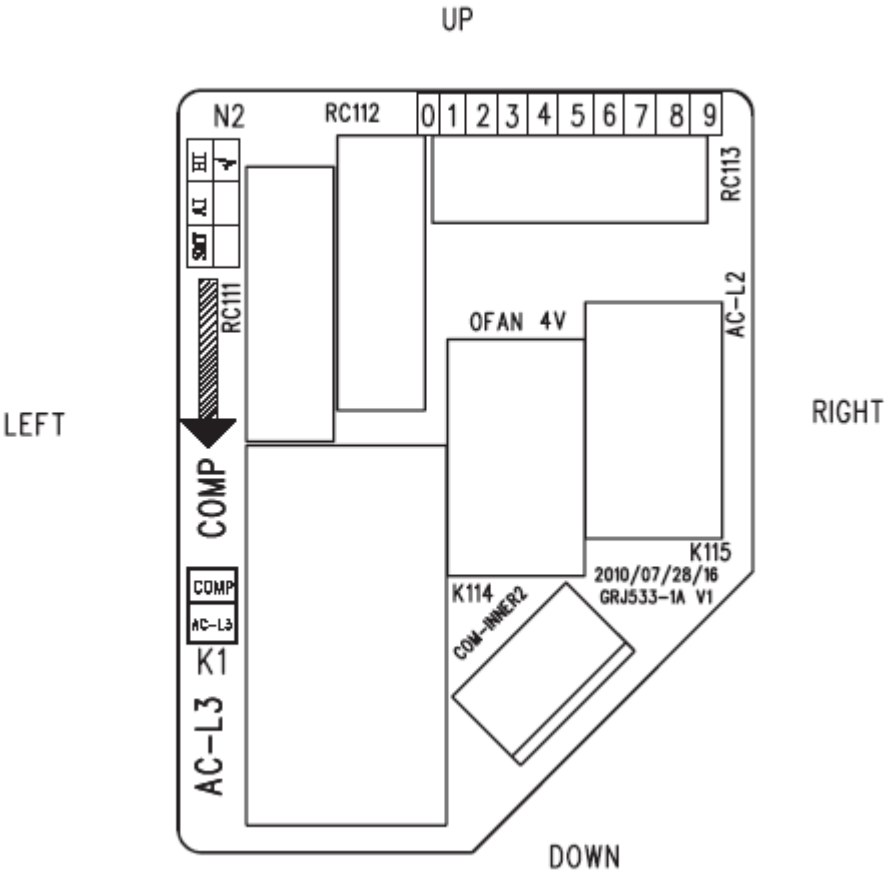


Down

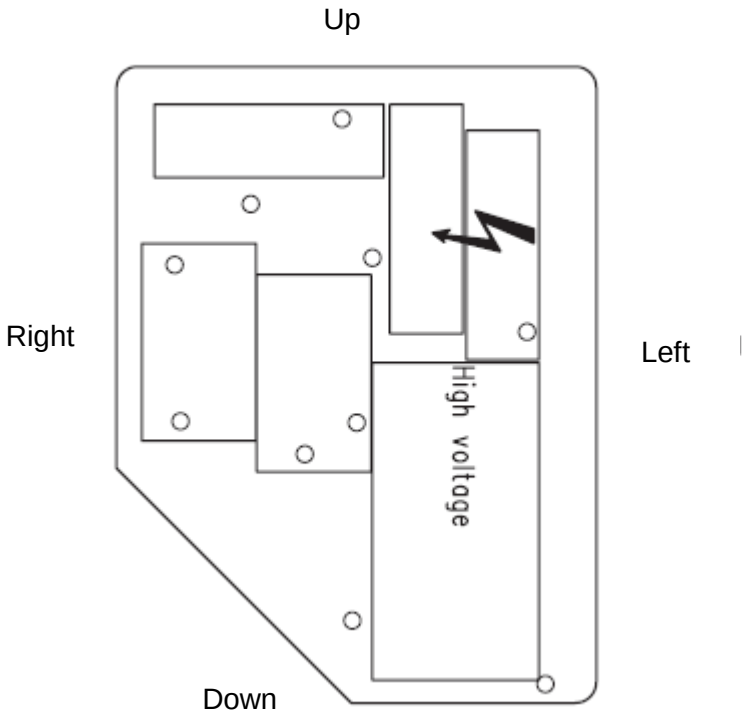
Do not modify electrical components or wiring, for replacements only use OEM spare-parts!

Relay Box (top-view)

Do not modify electrical components or wiring, for replacements only use OEM spare-parts!



Relay Box (bottom-view)



Functional description and controls

The remote control

1 **ON/OFF:** Press it to start or stop operation

2 **MODE:** Press it to select operation mode (AUTO/COOL/DRY/FAN/HEAT)

3 **+ :** Press it to increase temperature setting

4 **- :** Press it to decrease temperature setting

5 **FAN:** Press it to set fan speed

6 : Press it to set swing angle

7 **TIMER ON:** Press it to set auto-on timer

8 **TIMER OFF:** Press it to set auto-off timer

9 **CLOCK:** Press it to set clock

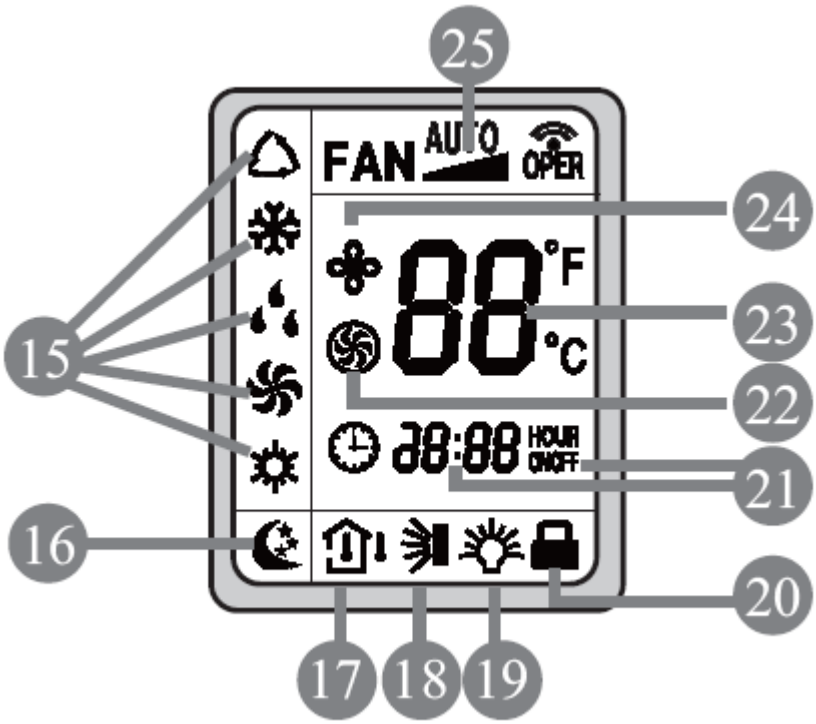
10 **X-FAN**

11 **TEMP**

12 **TURBO**

13 **SLEEP**

14 **LIGHT:** Press it to turn on/off the light.



15 **MODE icon:** If MODE button is pressed, current operation mode icon (AUTO), (COOL), (DRY), (FAN) or (HEAT is only for heat pump models) will show.

16 SLEEP icon: is displayed by pressing the SLEEP button. Press this button again to clear the display.

17 **TEMP icon:** Pressing TEMP button

(set temperature), (ambient temperature), (outdoor ambient temperature) and blank is again to clear the display.

18 **Up & down swing icon:** is displayed when pressing the up & down swing button. Press this button again to clear the display.

19 **LIGHT icon:** is displayed by pressing the LIGHT button.

.Press LIGHT button again to clear the display.

20 **LOCK icon:** is displayed by pressing "+" and "-" buttons simultaneously.

.Press them again to clear the display.

21 **SET TIME display:** After pressing TIMER button, ON or OFF will blink.

.This area will show the set time.

22 **TURBO icon:** is displayed when pressing the TURBO button.Press this button again to clear the display.

23 **DIGITAL display:** This area will show the set temperature. In SAVE mode,"SE" will be displayed. During defrosting operation, “H1” will be displayed.

24 **X-FAN icon:** is displayed when pressing the X-FAN button. Press this button again to clear the display.

25 **FAN SPEED display:** Press FAN button to select the desired fan speed setting(AUTO-Low- Med-High).Your selection will be displayed in the LCD windows, except the AUTO fan speed.

Unit Functions

1 **ON/OFF:** Press this button to turn on the unit. Press this button again to turn off the unit.

2 **MODE:** Each time you press this button,a mode is selected in a sequence that goes from AUTO, COOL,DRY, FAN, and HEAT *, as the following:

AUTO→COOL→DRY→FAN→HEAT *(*Note: Only for models with heating function.)

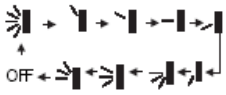
After energization, AUTO mode is defaulted. In AUTO mode, the set temperature will not be displayed on the LCD, and the unit will automatically select the suitable operation mode in accordance with the room temperature to make indoor room comfortable.

3 **+:** Press this button to increase set temperature. Hold it down for above 2 seconds to rapidly increase set temperature. In AUTO mode, set temperature is not adjustable.

4 **-:** Press this button to decrease set temperature. Hold it down for above . 2 seconds to rapidly decrease set temperature. In AUTO mode, set temperature is not adjustable.

5 **FAN:** This button is used for setting fan speed in the sequence that goes from AUTO, , , to , then back to Auto.

6 : Press this button to set up & down swing angle, which circularly changes as below:



This remote controller is universal. If any command , , is sent out, the unit will carry out the command as .

indicates the guide louver swings as:

7 **TIMER ON:** Press this button to initiate the auto-ON timer. To cancel the auto-timer program, simply press this button again. After pressing this button, disappears and " ON " blinks . 00:00 is displayed for ON time setting. Within 5 seconds, press + or - button to adjust the time value. Every press of either button changes the time setting by 1 minute. Holding down either button rapidly changes the time setting by 1 minute and then 10 minutes. Within 5 seconds after setting, press TIMER ON button to confirm.

8 **TIMER OFF:** Press this button to initiate the auto-off timer. To cancel the auto-timer program, simply press the button again.TIMER OFF setting is the same as TIMER ON.

9 **CLOCK:** Pressing CLOCK button, blinks. Within 5 seconds, pressing + or - button adjusts the present time. Holding down either button above 2 seconds increases or decreases the time by 1 minute every 0.5 second and then by 10 minutes every 0.5 second. During blinking after setting, press CLOCK button again to confirm the setting, and then will be constantly displayed.

10 **X-FAN:** Pressing X -FAN button in COOL or DRY mode,the icon is displayed and the indoor fan will continue operation for 10 minutes in order to dry the indoor unit even though you have turned off the unit.
After energization, X-FAN OFF is defaulted. X-FAN is not available in AUTO, FAN or HEAT mode.

11 **TEMP:** Press this button, could select displaying the indoor setting temperature or indoor ambient temperature.When the indoor unit firstly power on it will display the setting temperature, if the temperature's displaying status is changed from other status to " ",displays the ambient temperature, 5s later or within 5s, it receives other remote control signal that will return to display the setting temperature. if the users haven't set up the temperature displaying status,that will display the setting temperature.

12 **TURBO:** Press this button to activate / deactivate the Turbo function which enables the unit to reach the preset temperature in the shortest time. In COOL mode, the unit will blow strong cooling air at super high fan speed. In HEAT mode, the unit will blow strong heating air at super high fan speed. (This function is not applicable for some models).

13 **SLEEP:** Press this button to go into the SLEEP operation mode. Press it again to cancel this function. This function is available in COOL, HEAT (Only for models with heating function) or DRY mode to maintain the most comfortable temperature for you.

14 **LIGHT:** Press LIGHT button to turn on the display's light and press this button again to turn off the display's light. If the light is turned on, is displayed. If the light is tunrned off, disappears.

Combination of "+" and "-" buttons: About lock
Press "+ " and "-" buttons simultaneously to lock or unlock the keypad. If the remote controller is locked, is displayed. In this case, pressing any button, blinks three times.

Combination of "MODE" and "-" buttons: About switch between Fahrenheit and Centigrade
At unit OFF, press "MODE" and "- " buttons simultaneously to switch between °F and °C.

Replacement of batteries:

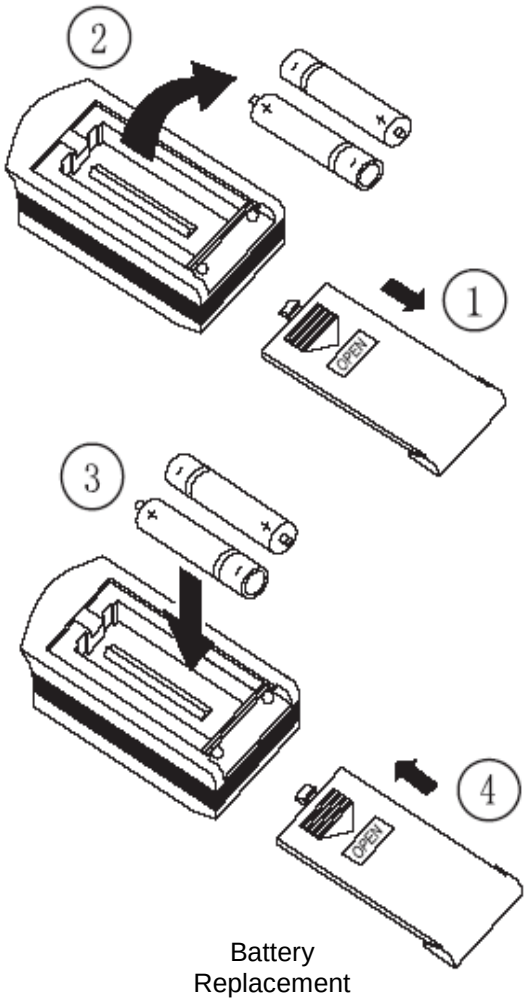
1: Remove the battery cover plate from the rear of the remote controller.
2: Take off the used batteries
3: Insert two new AAA1.5V batteries and pay attention to the polarity.
4: Reinstall the battery cover plate.

Please notice:
When replacing the batteries, do not use used or different types of batteries, otherwise it may cause malfunction.

If the remote controller will not be used for a long time, please remove batteries to avoid leaking.

Make sure that used batteries are disposed of according to local regulations. Most often batteries are not allowed to be part of domestic waste.

If the remote controller does not operate correctly, please take the batteries out and reinsert them after at least 30 seconds. If the malfunction is still valid, replace the batteries.



Battery Replacement

Functional specifications

Temperatures and basic functions

To describe the functions there are two temperatures applied.
The preset indoor temperature **(T_{preset})** and the ambient temperature **($T_{amb.}$)**.

After energizing the system, the compressor must not be restarted, after a standstill of at least three minutes. After a blackout, the compressor likewise can only be restarted after a time gap of at least three (3) minutes, provided that the system already was switched on (ON status). If the unit is at on status before power failure, the compressor shall be restarted with three minutes delay.

After having started the compressor, it runs for further six minutes even if the ambient temperature changes.

After switching on the unit, the compressor starts with three minutes time delay!

Cooling Mode

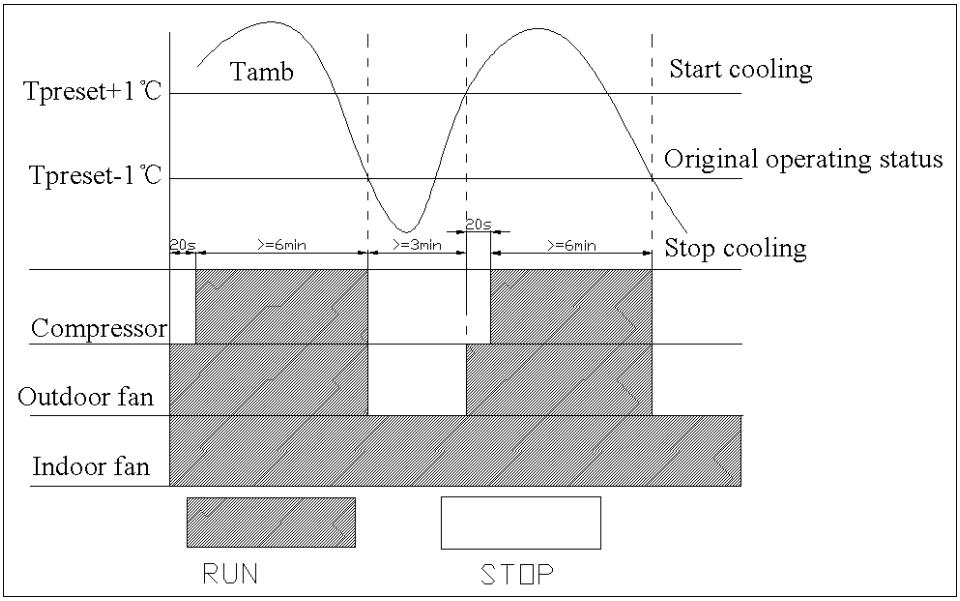
Conditions and process

The system starts cooling, if the ambient temperature is higher or equal to the preset temperature +1℃ ($T_{amb} \geq T_{preset}$ +1℃). Under this condition the compressor and the outdoor unit fan are running adequately to the requested performance. The indoor fan runs at the adjusted speed.

In case of lower or equal ambient temperature in comparison to the preset value -1℃ ($T_{amb} \leq T_{preset}$ -1℃), the compressor and the outdoor unit fan will be switched off. The indoor fan runs at the adjusted speed.

In the range of ambient temperature being higher than the preset value for -1℃ but lower than the preselection of + 1℃ (T_{preset} -1℃ < T_{amb} < T_{preset} +1℃) the system will not change its status.

As to that please compare the following schedule:



In this mode the temperature ranges between 16 to 30℃. On the display of the indoor unit the symbols “OPERATION, COOLING” and the temperature preset value are indicated.

DRY Mode

In general the air humidity will be reduced in cool mode. In dry mode extra drying is possible by reducing the fan speed.

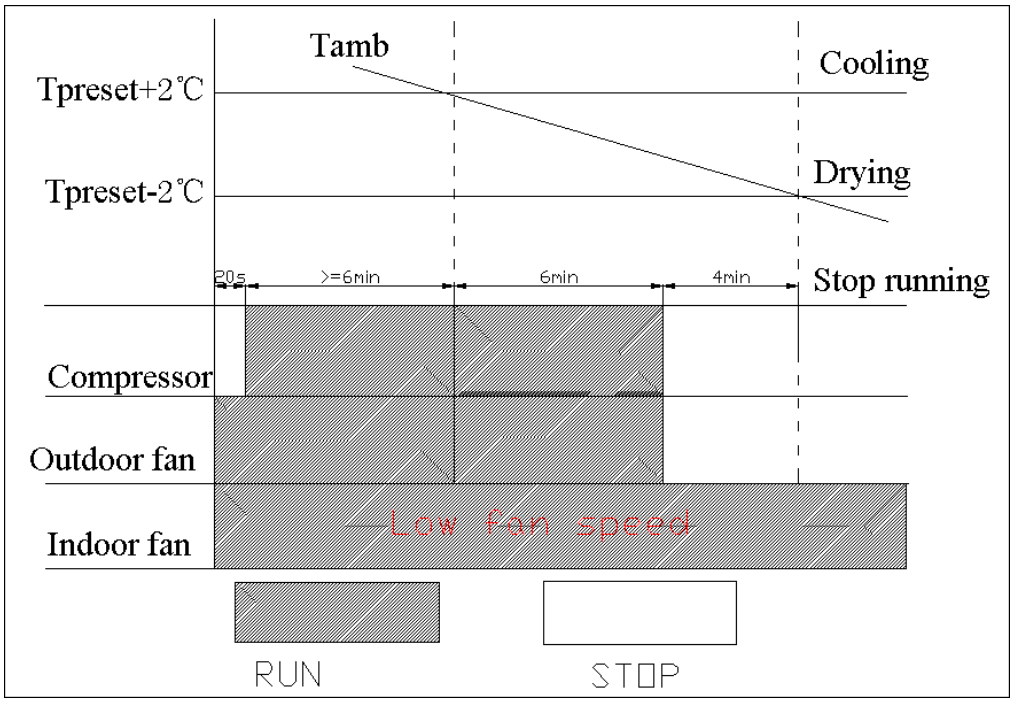
Dry Mode conditions and process

The system starts cooling and dehumidifying if the ambient temperature is higher or equal to the preset temperature +2℃ ($T_{amb} \geq T_{preset}$ +2℃).
Under this condition the compressor and the outdoor unit fan are running adequately to the requested performance. Meanwhile the fan of the indoor unit is decelerated to LOW position.

In case of higher or equal ambient temperature in comparison to the preset value -2℃, but lower or equal to the preset value of +2℃ (T_{preset} -2℃ ≤ T_{amb} ≤ T_{preset} +2℃), the system starts the dehumidifying functio n. So the fan of the indoor unit is decelerated to LOW position. The compressor, as well as the outdoor unit fan will run for six further minutes then they are switched off for four minutes. This cycle repeats in the DRY MODE.

In the range of ambient temperature being lower or equal to the preset value for -2℃ ($T_{amb} \leq T_{preset}$ -2℃), the system will switch off the compressor a nd the fan of the outdoor unit. The fan of the indoor unit is decelerated to LOW position.

As to that please compare the following schedule:



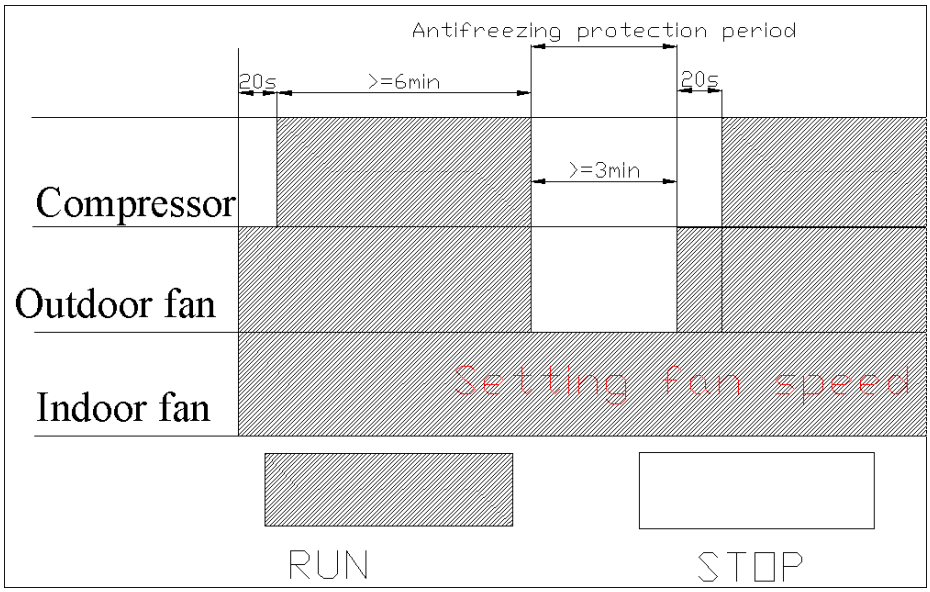
The temperature ranges between 16 to 30℃. On the d isplay of the indoor unit the symbols “OPERATION, COOLING” and the temperature preset value are indicated.

Protective functions

Anti-Freezing Protection

The system is fitted with an anti-freezing protection. This prevents the evaporator being covered with ice. Additionally, the system supervises the evaporator. In case ice formation is detected, the anti–freezer is automatically activated. By that the compressor and the outdoor unit fan are de-energised, while the indoor unit fan maintains running at the optional preselected speed.

Fixing the hazard of ice formation and having switched off the compressor for at least three minutes, the system restarts in the formerly (preselected) mode.
By way of illustration please compare to the figure:



Overload Protection

The system is equipped with an overvoltage protection that should avoid damage to the systems components.

As soon as the system exceeds the permissible stress for three consecutive seconds, the system will stop every function apart from the indoor unit fan, which runs further.

If there won't be an overvoltage metered three minutes later, the system restarts automatically and resume working with the pre-assigned mode.

In case of tripping the overvoltage protection for overall six times in succession, the system ceases operating, except the indoor unit fan. After that cutoff, you should deactivate the system completely by the remote control unit and reboot it.

E5 Error Code: "Evaporator temperature too high protection"

Refer page 105 for further error code clarifications.

While the overvoltage protection is active, the display of the indoor unit shows the error code E 5. In addition to that, the operation indicator lamp flashes five times, interrupted by a break of three seconds. If the compressor runs for at least six minutes at a stretch, the counter for the overvoltage protector will be reset.

"Evaporator Temperature To High" protection

FAN MODE

Using this mode the indoor unit fan runs at its preselected speed. Any other part of the system (compressor and outdoor unit fan) is de-energised.

The pre-selection of temperature may range between 16 and 30℃. The indoor unit display signals the Icon OPERATION beside the preselected temperature.

AUTO MODE

Opting the AUTO mode, system changes to the action, which considers close to the registered room condition (COOLING or FAN). Concerning the modes check against upside.

The indoor unit display shows you the icon OPERATION, as well as matching to the actual choice, the dedicated icon (COOLING, FAN). Moreover the preselected temperature is displayed.

Please note the delay of 30 seconds before the system changes mode.
The safety functions correspond to those in the particularly represented mode.

Other adjustments and functions of the remote controller

Timer function

The system is equipped with two Timer settings as there is the common Timer and a Time pre-selection. These Timers can be optionally adjusted by the remote control unit.

General Timer

If the system is switched off, the Timer can be switched ON. By reaching the time preset, system restarts in the same manner as before the switch is off. The interval of the Timer adjustment is half an hour and can be set from 0.5 up to 24 hours.

Timer function may be adjusted while system operation is in OFF position. As soon as the preselected time is over, the system stops automatically. The interval is even 0.5 hours, time setting from 0.5 up to 24 hours.

Clock Timer

Tripping the Timer ON when the system operates, it will continue operation. If the system is de-energised, when the Timer is switched ON, it will restart after the preselected time under the previously chosen conditions.

Putting the timer in OFF position in system standstill, it stays de-energised. In case the timer is switched in OFF position during system operation, it will go on until it reaches the preselected time set.

Timer Change

If the system is activated in a certain timer status (to be seen above) it can be switched ON/OFF by pressing the corresponding key. Timer will be reset.
Putting the timer in ON, as well as OFF during system operation, it continues operation into the preset time (Timer OFF) is over. Then it will stop automatically.
If there are two timer sets for ON and OFF Timer during system standstill, it remains disconnected until the ON Timer is reached. It is reinitiated after that.

Buzzer

Whenever the indoor unit gets a signal - pushing a button on the unit itself or on the remote control unit – or by switching on, it makes a sound.

Sleep function

This function gives a selection of diverse graphics of preselected temperatures for sleep time.

Turbo Function

This function may be set in COOLING mode.

Automatic Control of Fan speed

The system will automatically choose the speed of the indoor unit fan (LOW, MEDIUM, HIGH), dependent on the ambient temperature.

Air flow direction

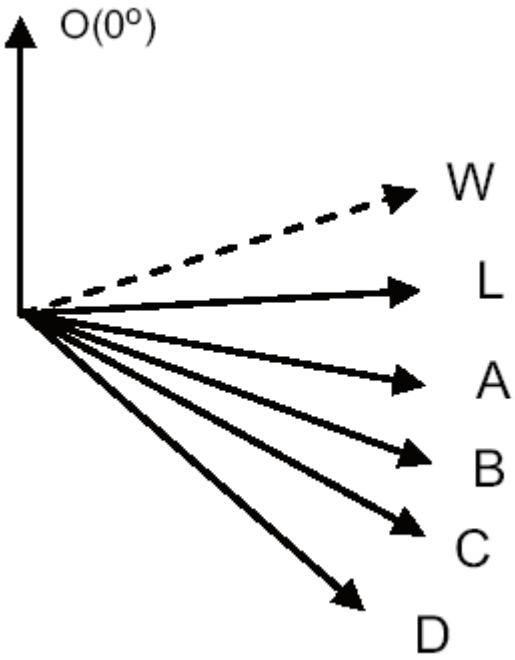
As described above, the indoor unit is able to blow out air into various directions. After energizing the system the electric motor moves the air flap counterclockwise in zero position to close the air outlet.

Switching on the system and no flap move or swing is adjusted, the motor will move the air outlet flap clockwise to L.

If the system is energized and a swing was preselected, the flap will move matching the preset between D and L position. There are 7 possible adjustments to be chosen (look ahead) in addition to L, A, B, C, D and 0.

De-energising the system the flap will move to zero position.

Please note: If the position is set by the remote control unit between I and B, A and C or B and D, the air outlet flap anyhow goes between the positions L and D.



Display

Activating the indoor unit, every icon will beam. In stand-by condition, operation indicator will shine red. Starting the system by the remote control unit, the operation indicator is ON and the corresponding icons will appear in the actual mode (COOLING, DRY, FAN).

Error Codes

Error codes illuminate with specific system failure or components deficiency conditions.

Please refer to page 105 for decoding of the specific error codes:

H6 Error Code Indicates low speed or not functional outdoor unit fan.

Refer page 105 and 107 for further error code clarifications.

Locked protection to Outdoor Unit fan motor (PG motor)

When starting the fan, if the motors rotational speed is slow for a period of time, the unit will display LOCKED and stop running to avoid auto protection of the compressor motor. If the system is energized the indoor unit will display H6.

Memory function

The system memorises the files for the different system modes, air swing flap angle, light, temperature preset and fan speed.

Having reconstructed the power supply after a blackout, the system will continue its operation corresponding to the filed parameters. If there has been a timer adjustment, which has not yet worked out, the system recalculates the timer duration with the assistance of the stored information and will perform adequately. The clock timer cannot be saved.

HC R290 refrigerant issues

Basics

HC R-290 (propane) is an odourless and colourless gas of the group of hydrocarbons. HC R-290 is heavier than air and at high concentrations can cause narcotic effects and eventually asphyxiation.

R-290 is highly flammable within the range of 2.1% and 9.5% by volume, or 38 g/m^3 to 170 g/m^3 in air. The auto-ignition temperature is about 470℃.

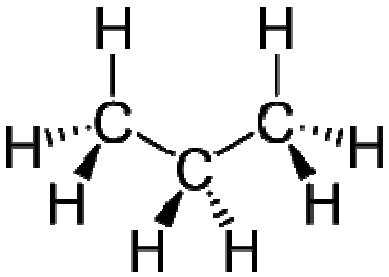
Since R-290 is an odourless and colourless gas, it is difficult to perceive that it is present (as with most other refrigerants).

Propane is often used as a fuel, such as for heating or barbecues. However, for use on refrigeration systems, fuel-grade propane is not suitable since it contains high levels of impurities, which would damage the refrigeration system and may not provide the desired refrigerating capacity or efficiency.

HC R-290 refrigerant has a high grade of purity.

Propane as a cooking gas is not useful for refrigeration purpose!

The structural formula of HC R-290 (propane)



Important refrigerant properties and parameters:

Molecular formula	C_3H_8
Melting point [℃]	-188
Boiling point under atmospheric pressure [℃]	-42
Molar mass [g mol $^{-1}$]	44.10
Critical temperature [℃]	96.8
Critical pressure [bar]	42
Practical limit [g/m^3]	8
Lower flammability level LFL [g/m^3]	38
Lower flammability level LFL [%]	2.1
Upper flammability level UFL [g/m^3]	171
Upper flammability level UFL [%]	9.5
Ignition temperature [℃]	470

Read More!

Guidlines for the safe use of hydrocarbon refrigerants

GIZ—PROKLIMA

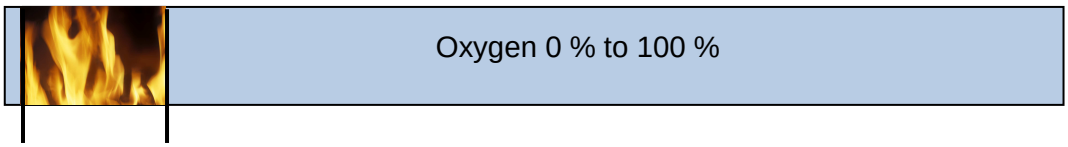
http://www.giz.de/proklima

Flammability

Three components are needed simultaneously for causing fire:

1. Oxygen
2. Ignition source and
3. The flammable concentration of HC

For ignition, the concentration of HC in air has to be between the lower and upper flammable limits. If the concentration is below the lower flammability limit (LFL) of about 2% by volume in air, there is not enough HC for combustion. If the concentration is above the upper flammability limit (UFL) of about 10% there is insufficient oxygen for combustion.



2 % **10 %**

HC R-290 Refrigerant

By way of illustration please compare to the schematic view:

To ignite HC R-290, three (3) components must exist at the same time at work area to cause the refrigerant burning!

Possible ignition sources are:

1. A flame, for example from brazing torch, halide torch leak lamp, match or lighter, cigarette
2. A spark from an electrical component
3. Static electricity
4. Hot surfaces

Safety data

Hazard Identification

- Extremely flammable (F+).
- Readily forms an explosive air-vapour mixture at ambient temperatures.
- Vapour is heavier than air and may travel to remote sources of ignition (e.g. along drainage systems, into basements etc).
- Liquid releases generate large volumes of flammable vapour (approx. 250:1)
- Cold burns (frostbite) will result from skin / eye contact with liquid.
- Liquid release or vapour pressure jets present a risk of serious damage to the eyes.
- Abuse involving inhalation of high concentrations of vapour, even for short periods, can produce unconsciousness or may prove fatal. Inhalation may cause irritation to the nose and throat, headache, nausea, vomiting, dizziness and drowsiness. In poorly ventilated areas unconsciousness or asphyxiation may result.

1 kg of liquid HC R-290 refrigerant creates about 250 litres of gas

Beside the flammability, most other safety properties are similar to other refrigerants!

Rely always on best service practices in refrigeration!

First Aid Measures

Inhalation:
Remove the affected person to fresh air. If breathing has stopped, administer artificial respiration. Give external cardiac massage if necessary. If the person is breathing but unconscious, place them in the recovery position. Obtain medical assistance immediately.

Skin:
In case of cold burns: flush with water to normalize temperature. Cover the burns with sterile dressings Do not use ointments or powders. Obtain medical assistance immediately.

Eyes:
Cold burns should be flushed with water to normalise temperature, cover the eye with a sterile dressing and obtain medical assistance immediately.

Fire Fighting Measures

HC R-290 is delivered, stored, and used at temperatures above their flash point. Avoid all naked flames, sparks, cigarettes, etc.

- In case of fire, immediately alert fire brigade
- Ensure an escape path is always available from any fire
- If gas has ignited do not attempt to extinguish but stop gas flow and allow to burn out.
- Use water spray to cool heat-exposed containers, and to protect surrounding areas and personnel effecting the shut off
- Every precaution must be taken to keep containers cool to avoid the possibility of a boiling liquid expanding vapour explosion (BLEVE)

Extinguishing Media:

In case of a large fire:
Release must be stopped and container cooled by water spray.
Water mist should be used to assist approach to the source of the fire.
Large fires should only be handled by Fire Brigade.

DO NOT USE WATER JET

Small fire:
Use dry powder extinguisher

DO NOT USE WATER OR FOAM

Special protective equipment for fire fighters:
In confined spaces use self-contained breathing apparatus

Hazardous combustion products:
Incomplete combustion may form carbon monoxide.

Accidental Release Measures

Immediate emergency action:

- Clear people away from the area to a safe place
- Do not operate electrical equipment unless “Ex”-rated
- Summon the emergency services
- Treat or refer casualties if necessary

Further actions:

- Stop release
- Use dry powder or carbon dioxide extinguishers
- Cool containers exposed to fire by using water / mist spray.

Further action (when release is made safe):

- Extinguish all naked lights – avoid creating sparks
- Position fire fighting equipment
- Cover drains and disperse vapour with water spray. Note: vapour may collect in confined spaces.

The handling of HC R-290

Due to the flammability of R-290 and the risk of fire or explosion during servicing, special safety rules must be followed during operation. In order to avoid damage for people and property, particular requirements are listed hereafter.

Before servicing the unit, the surrounding area were the work will be done must be clear of safety hazards to ensure safe working. Nevertheless it is required to carry out a risk assessment in order to minimise the risk of ignition of R-290.

The following safety measures must be followed:

1. Any employees and other present persons must be informed about the service and the way the service is done, first.
2. It is recommended to isolate the working environment in order to keep out any unauthorised personnel.
3. It is useful to set up signs such as “no smoking“ or “access denied“.
4. It is prohibited to store any combustible goods within the working environment.
5. Within two (2) metres radius, ignition sources are not allowed in the working area.
6. Fire extinguisher (dry powder) must be easily accessible at any time.
7. During service work, proper ventilation of the environment must be ensured.

Sign plate to protect and mark the working area

The HC leak detector is indeed a Personal Protective Equipment (PPE) device!

Appropriate detectors, suitable for hydrocarbons, must be available and operational all the time. Appropriate tools and appliances must be available and ready for operation. **Any employees need to be instructed extensively about the safety measures and the possible safety hazard.**

Refrigerant recovery

Before starting service work on the refrigerant circuit, the existing refrigerant must be removed. When carrying out removal of the refrigerant, the following must be considered:

- The recovery cylinder must be permitted for the use of R-290 (especially regarding the pressure and the compatibility of the connectors and the valves).
- The recovery machine must be suitable for operation with R-290. Importantly, the recovery machine must not itself be an ignition source.
- The filling of the recovery cylinder should be monitored closely by controlling the weight. It is recommended to place and then to leave the cylinder on a digital scale. Pay attention not to overfill the cylinder. The cylinder is only allowed to be filled up to 80% of its complete volume by liquid refrigerant.
- The pressure must be controlled in order to ensure that the permissible pressure of the cylinder is not exceeded at any time.
- After filling, the cylinder must be marked with the mass and the type of refrigerant recovered.
- The recovery machine should be operated until the pressure reduces to 0.3 bar absolute pressure. R-290 is soluble to oil. This may lead to a rise in pressure because the refrigerant vaporises from oil. It may be necessary to operate the recovery machine for a second or even a third time.
- Small amounts of R-290 can be vented in safe manner to the environment.
- Remaining amounts of HC absorbed by the oil can be extracted from the system using a vacuum pump in combination with an exhaust vent hose.
- A second “two way excess” recovery cylinder can be used in serial connection to act as an oil-separator.
- After the systems‘ pump out, the system should be flushed with oxygen-free dry nitrogen (OFDN) in order to ensure no flammable gas are inside the system.

Repair of leaks

System leaks must be immediately repaired by authorised personnel after becoming acquainted. If they cannot be repaired immediately, the refrigerant charge should be removed from the system until the point at which the leak can be properly repaired.

Repairs must be done principally using the following procedures:

- Removing the refrigerant from the system in order to avoid an uncontrolled discharge.
- Examine the leak source, determining the reason for the leak and carry out the proper course of action
- Repair properly (NO “temporary repairing”)
- Based on the results of the systems’ examination, suitable measures need to be identified in order to avoid a recurrent appearance of the leak.
- Before embarking on the repair, ensure that the refrigerant has been removed and the system flushed with OFDN, especially if brazing is to take place
- After each intervention into a refrigeration system (repairing leaks, replacing components, brazing) the system must be subject to a leak test and following strength test of the system.

Regular professional brazing experience is an important precondition for the work with hydrocarbon refrigerants!

The use OFDN is an important precondition for professional leak repair!

1. **System flushing from HC**
2. **Inert gas brazing**
3. **Leak testing**
4. **Strength testing**
5. **Cleaning (blowing) agent**

Gas detection

The HC leak detector is indeed a PPE device!

While servicing the unit it is recommended for the whole period of work — before, during and after — to monitor the gas concentration in the air within the work environment. By monitoring the air within the work environment the danger of a possible formation of flammable atmosphere can be detected early.

During the monitoring, ensure that the gas detectors are suitable for hydrocarbon detection. Never use open fire or a device with an ignition source for the detection of gas or for leak detection.

Before operation of the gas detector the instruction manual must be read carefully. In case of any questions refer to the detector manufacturer. Furthermore ensure the detector is correctly calibrated. Instructions for calibration can be found in the instruction manual of the detector or upon request from the manufacturer. A possible re-calibration must be done within an area which is free of refrigerants.

In case of a positive detection by the detector any work must be stopped immediately. Any open flames or ignition sources must be extinguished or removed.

In addition to a suitable and approved HC gas detectors, portable gas detectors can be used.

Such a detector can be clipped to clothing or placed on the floor within the working area. It should be switched on for the duration of the work, and set to alarm at 15% of the lower flammability level (LFL), to warn that flammable concentration may be nearby. In this way, technicians can be alerted whenever an inadvertent release of flammable refrigerant occurs, and can immediately act upon the relevant emergency procedures.

Portable HC Gas Detector

Cylinder handling

R-290 is available in a large variety of different cylinders, which are to be distinguished whether they are refillable or not. Most refillable cylinders are equipped with pressure relief valves, often with own special construction of valves in order to distinguish them from the cylinders of different refrigerants.

Often special legal requirements about the handling of flammable refrigerants exist in the different countries. These requirements must be studied and adhered to. Principally the following regulations in dealing with R-290 cylinders apply:

1. Do not remove or destroy official stickers of the cylinder
2. Close the cylinder with a cap any time the cylinder is not used
3. Never expose the cylinder to direct heat
4. Do not repair or modify the cylinder or the cylinders‘ connections
5. Only use suitable equipment for transportation of the cylinder, even for short distances. Never roll the cylinder across the ground.
6. Take appropriate measures in order to prevent impurities, water or oil from entering the cylinder.
7. Should it be necessary to warm the cylinder, only use warm water or air in which the temperature must not exceed 40℃ (104℉). Open flames or radiant heaters are not allowed at any time.
8. Weigh the cylinder and compare it against the tare weight (normally stamped on the cylinder) in order to make sure that it is empty. Pressure control is no secure method to find out if and how much refrigerant there is inside the cylinder.
9. For accurate charging, use a set of reliable scales with appropriate resolution (depending on the size of system charged with refrigerant) and use the smallest size of cylinder available.
10. For recovery of R-290, only use cylinders which are allowed to be filled with R-290.
11. Make sure that safety inspections are still valid (i.e. within date), specifically with regards to safety test certification.
12. For refillable recovery cylinders keep in mind that with recovered amounts of HC refrigerant, oil will always be present specific amounts may remain in the cylinder after emptying.

Charging HC!

Always use the smallest cylinder possible and relay on appropriate accurate and sensitive scales

The storage of R-290 cylinders is controlled by regulations. These regulations take priority over the present guidelines. Typically, such rules imply the following:

1. Cylinders should be stored in a separate area, preferably outside, otherwise in a dry, well ventilated place far away from any ignition source.
2. Admission to storage area must only be given to authorised personnel. Storage areas must be labelled with “no smoking” and “no naked flames” signs.
3. Storage areas should be at ground level and never in the basement.
4. Access should be easy – exclude any obstacles.
5. Cylinders should be stored and operated only in an upright position.
6. Choose appropriate measures to prevent static charges
7. Please remember that the maximum quantity of stored refrigerant sometimes might be regulated by national regulations.

The transport of cylinders is controlled by laws in most countries. These laws must always be regarded first before the mentioned guidelines here. In many cases information about regulations for the transport of cylinders could be given by the dealer of the refrigerant.

Read More!

Guidlines for the safe use of hydrocarbon refrigerants

GIZ—PROKLIMA

http://www.giz.de/proklima

Basically the following must be regarded concerning the transport of R-290 cylinders:

1. During the transportation of R-290 always carry along printed information about the refrigerant. In case of emergency these information must be easily accessible. There are often different demands to the transporters carrying a great quantity of gas. Inform yourself before the scheduled transport.
2. Make yourself familiar with the risks of the refrigerant and the emergency measures in case of accident or emergency.
3. Always carry a fire extinguisher during transportation with you. It should be a dry powder fire extinguisher with a capacity of at least of 2 kg. Make sure that the driver is experienced in fire extinguisher operation.
4. Cylinders must be transported in an upright position and be tightly secured.
5. Make sure of a proper ventilation inside the van even though it might request a change in the vans‘ body construction.
6. Place the security advise “flammable gas“ upon the rear side of the van.
7. Smoking or open fire is strictly forbidden inside the van.
8. Do not leave cylinders in a locked van without surveillance longer than necessary.

Pressure—Temperature Chart

HC Refrigerant R-290							
Temperature		Absolute pressure			Gauge pressure		
°C	°F	kPa	bar	PSI	kPa(g)	bar(g)	PSI(g)
-40	-40	111,12	1,11	16,12	11,12	0,11	1,61
-39	-38,2	116,00	1,16	16,83	16,00	0,16	2,32
-38	-36,4	121,05	1,21	17,56	21,05	0,21	3,05
-37	-34,6	126,27	1,26	18,31	26,27	0,26	3,81
-36	-32,8	131,66	1,32	19,10	31,66	0,32	4,59
-35	-31	137,23	1,37	19,90	37,23	0,37	5,40
-34	-29,2	142,97	1,43	20,74	42,97	0,43	6,23
-33	-27,4	148,90	1,49	21,60	48,90	0,49	7,09
-32	-25,6	155,02	1,55	22,48	55,02	0,55	7,98
-31	-23,8	161,33	1,61	23,40	61,33	0,61	8,89
-30	-22	167,83	1,68	24,34	67,83	0,68	9,84
-29	-20,2	174,54	1,75	25,31	74,54	0,75	10,81
-28	-18,4	181,44	1,81	26,32	81,44	0,81	11,81
-27	-16,6	188,56	1,89	27,35	88,56	0,89	12,84
-26	-14,8	195,89	1,96	28,41	95,89	0,96	13,91
-25	-13	203,43	2,03	29,51	103,43	1,03	15,00
-24	-11,2	211,19	2,11	30,63	111,19	1,11	16,13
-23	-9,4	219,18	2,19	31,79	119,18	1,19	17,29
-22	-7,6	227,39	2,27	32,98	127,39	1,27	18,48
-21	-5,8	235,84	2,36	34,21	135,84	1,36	19,70
-20	-4	244,52	2,45	35,46	144,52	1,45	20,96
-19	-2,2	253,44	2,53	36,76	153,44	1,53	22,26
-18	-0,4	262,61	2,63	38,09	162,61	1,63	23,58
-17	1,4	272,03	2,72	39,45	172,03	1,72	24,95
-16	3,2	281,70	2,82	40,86	181,70	1,82	26,35
-15	5	291,62	2,92	42,30	191,62	1,92	27,79
-14	6,8	301,81	3,02	43,78	201,81	2,02	29,27
-13	8,6	312,27	3,12	45,29	212,27	2,12	30,79
-12	10,4	323,00	3,23	46,85	223,00	2,23	32,34
-11	12,2	334,00	3,34	48,44	234,00	2,34	33,94
-10	14	345,28	3,45	50,08	245,28	2,45	35,58
-9	15,8	356,85	3,57	51,76	256,85	2,57	37,25
-8	17,6	368,70	3,69	53,48	268,70	2,69	38,97
-7	19,4	380,85	3,81	55,24	280,85	2,81	40,73
-6	21,2	393,29	3,93	57,04	293,29	2,93	42,54
-5	23	406,04	4,06	58,89	306,04	3,06	44,39

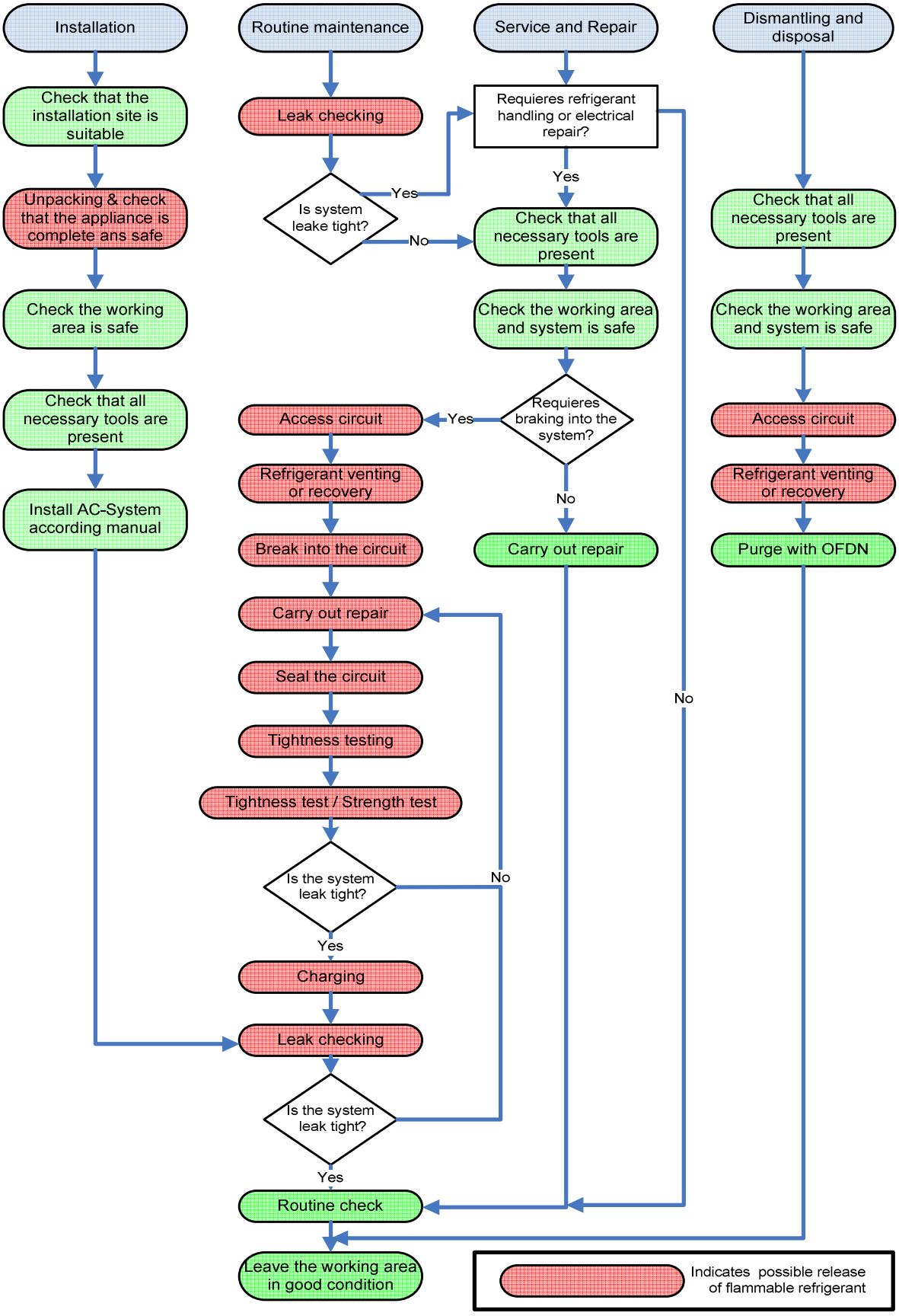
HC Refrigerant R-290							
Temperature		Absolute pressure			Gauge pressure		
°C	°F	kPa	bar	PSI	kPa(g)	bar(g)	PSI(g)
-4	24,8	419,09	4,19	60,78	319,09	3,19	46,28
-3	26,6	432,45	4,32	62,72	332,45	3,32	48,22
-2	28,4	446,13	4,46	64,71	346,13	3,46	50,20
-1	30,2	460,13	4,60	66,74	360,13	3,60	52,23
0	32	474,46	4,74	68,82	374,46	3,74	54,31
1	33,8	489,11	4,89	70,94	389,11	3,89	56,44
2	35,6	504,10	5,04	73,11	404,10	4,04	58,61
3	37,4	519,43	5,19	75,34	419,43	4,19	60,83
4	39,2	535,10	5,35	77,61	435,10	4,35	63,11
5	41	551,12	5,51	79,93	451,12	4,51	65,43
6	42,8	567,49	5,67	82,31	467,49	4,67	67,80
7	44,6	584,22	5,84	84,74	484,22	4,84	70,23
8	46,4	601,31	6,01	87,21	501,31	5,01	72,71
9	48,2	618,77	6,19	89,75	518,77	5,19	75,24
10	50	636,60	6,37	92,33	536,60	5,37	77,83
11	51,8	654,81	6,55	94,97	554,81	5,55	80,47
12	53,6	673,40	6,73	97,67	573,40	5,73	83,17
13	55,4	692,38	6,92	100,42	592,38	5,92	85,92
14	57,2	711,75	7,12	103,23	611,75	6,12	88,73
15	59	731,51	7,32	106,10	631,51	6,32	91,59
16	60,8	751,68	7,52	109,02	651,68	6,52	94,52
17	62,6	772,25	7,72	112,01	672,25	6,72	97,50
18	64,4	793,24	7,93	115,05	693,24	6,93	100,55
19	66,2	814,64	8,15	118,16	714,64	7,15	103,65
20	68	836,46	8,36	121,32	736,46	7,36	106,82
21	69,8	858,71	8,59	124,55	758,71	7,59	110,04
22	71,6	881,39	8,81	127,84	781,39	7,81	113,33
23	73,4	904,51	9,05	131,19	804,51	8,05	116,69
24	75,2	928,07	9,28	134,61	828,07	8,28	120,10
25	77	952,07	9,52	138,09	852,07	8,52	123,58
26	78,8	976,53	9,77	141,64	876,53	8,77	127,13
27	80,6	1001,45	10,01	145,25	901,45	9,01	130,75
28	82,4	1026,83	10,27	148,93	926,83	9,27	134,43
29	84,2	1052,68	10,53	152,68	952,68	9,53	138,18
30	86	1079,00	10,79	156,50	979,00	9,79	141,99
31	87,8	1105,79	11,06	160,38	1005,79	10,06	145,88

HC Refrigerant R-290							
Temperature		Absolute pressure			Gauge pressure		
°C	°F	kPa	bar	PSI	kPa(g)	bar(g)	PSI(g)
32	89,6	1133,08	11,33	164,34	1033,08	10,33	149,84
33	91,4	1160,85	11,61	168,37	1060,85	10,61	153,87
34	93,2	1189,12	11,89	172,47	1089,12	10,89	157,97
35	95	1217,88	12,18	176,64	1117,88	11,18	162,14
36	96,8	1247,16	12,47	180,89	1147,16	11,47	166,38
37	98,6	1276,94	12,77	185,21	1176,94	11,77	170,70
38	100,4	1307,24	13,07	189,60	1207,24	12,07	175,10
39	102,2	1338,07	13,38	194,07	1238,07	12,38	179,57
40	104	1369,42	13,69	198,62	1269,42	12,69	184,12
41	105,8	1401,31	14,01	203,25	1301,31	13,01	188,74
42	107,6	1433,73	14,34	207,95	1333,73	13,34	193,44
43	109,4	1466,71	14,67	212,73	1366,71	13,67	198,23
44	111,2	1500,23	15,00	217,59	1400,23	14,00	203,09
45	113	1534,31	15,34	222,54	1434,31	14,34	208,03
46	114,8	1568,96	15,69	227,56	1468,96	14,69	213,06
47	116,6	1604,18	16,04	232,67	1504,18	15,04	218,17
48	118,4	1639,97	16,40	237,86	1539,97	15,40	223,36
49	120,2	1676,34	16,76	243,14	1576,34	15,76	228,63
50	122	1713,30	17,13	248,50	1613,30	16,13	233,99
51	123,8	1750,86	17,51	253,94	1650,86	16,51	239,44
52	125,6	1789,02	17,89	259,48	1689,02	16,89	244,98
53	127,4	1827,79	18,28	265,10	1727,79	17,28	250,60
54	129,2	1867,17	18,67	270,81	1767,17	17,67	256,31
55	131	1907,17	19,07	276,62	1807,17	18,07	262,11
56	132,8	1947,80	19,48	282,51	1847,80	18,48	268,01
57	134,6	1989,07	19,89	288,49	1889,07	18,89	273,99
58	136,4	2030,98	20,31	294,57	1930,98	19,31	280,07
59	138,2	2073,54	20,74	300,75	1973,54	19,74	286,24
60	140	2116,75	21,17	307,01	2016,75	20,17	292,51

Flow of Work for AC– System Installation, Service, Repair and Dismantling

The main concern for involved service personal is to avoid the release of any refrigerant during installation, maintenance, repair and service of the HC R-290 air-conditioning system.

The following chart shall highlight important work flow activities and where specific care should take place!


Installation
Routine maintenance
Service and Repair
Dismantling and disposal
Check that the installation site is suitable
Leak checking
Requieres refrigerant handling or electrical repair?
Unpacking & check that the appliance is complete ans safe
Is system leake tight?
Yes
No
Check that all necessary tools are present
Check the working area is safe
Check the working area and system is safe
Check that all necessary tools are present
Requieres braking into the system?
Access circuit
Refrigerant venting or recovery
Break into the circuit
Carry out repair
Install AC-System according manual
Carry out repair
Seal the circuit
Tightness testing
Tightness test / Strength test
Is the system leak tight?
Charging
Leak checking
Is the system leak tight?
Routine check
Leave the working area in good condition
Purge with OFDN
Indicates possible release of flammable refrigerant

Installation

Important Notes

The installation of the system is only permitted by trained personnel strictly following the local country rules and regarding the guidelines of this manual. Please refer to a local authorised service centre before installation. The same applies when removing an existing and installed system to another place.

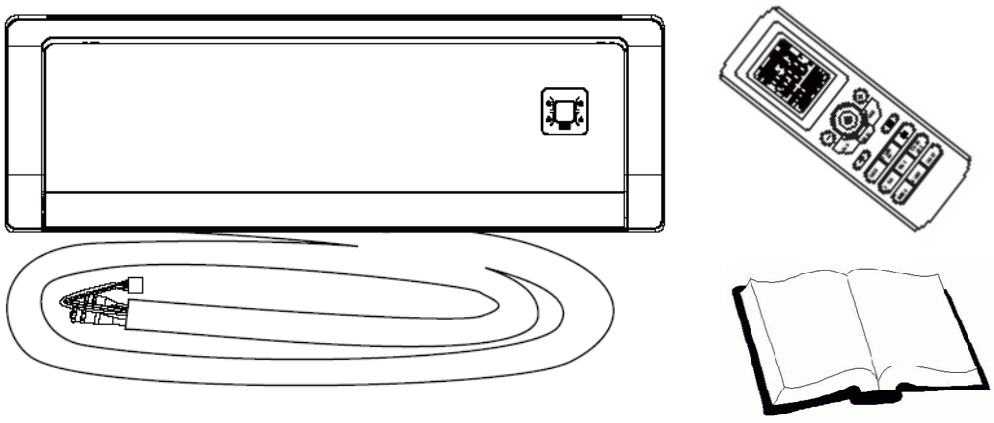
Delivery conditions of Indoor and Outdoor Unit

The system components are delivered in a pre-installed condition. With delivery, the two main components (indoor– and outdoor-unit) are pressurised and contain the complete HC R-290 refrigerant charge amount of the functional AC system. For installation, besides mounting the indoor and the outdoor unit, it is only necessary to make the connection between the two units with the already installed and pressurised refrigerant transfer pipes and electrical connection cabling.

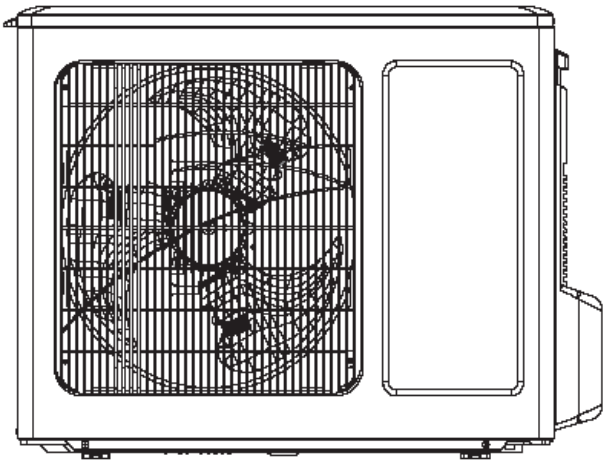
The HC R-290 AC delivery package consist of the following components:

The Indoor Unit with attachments, mounting support, remote controller and documentation

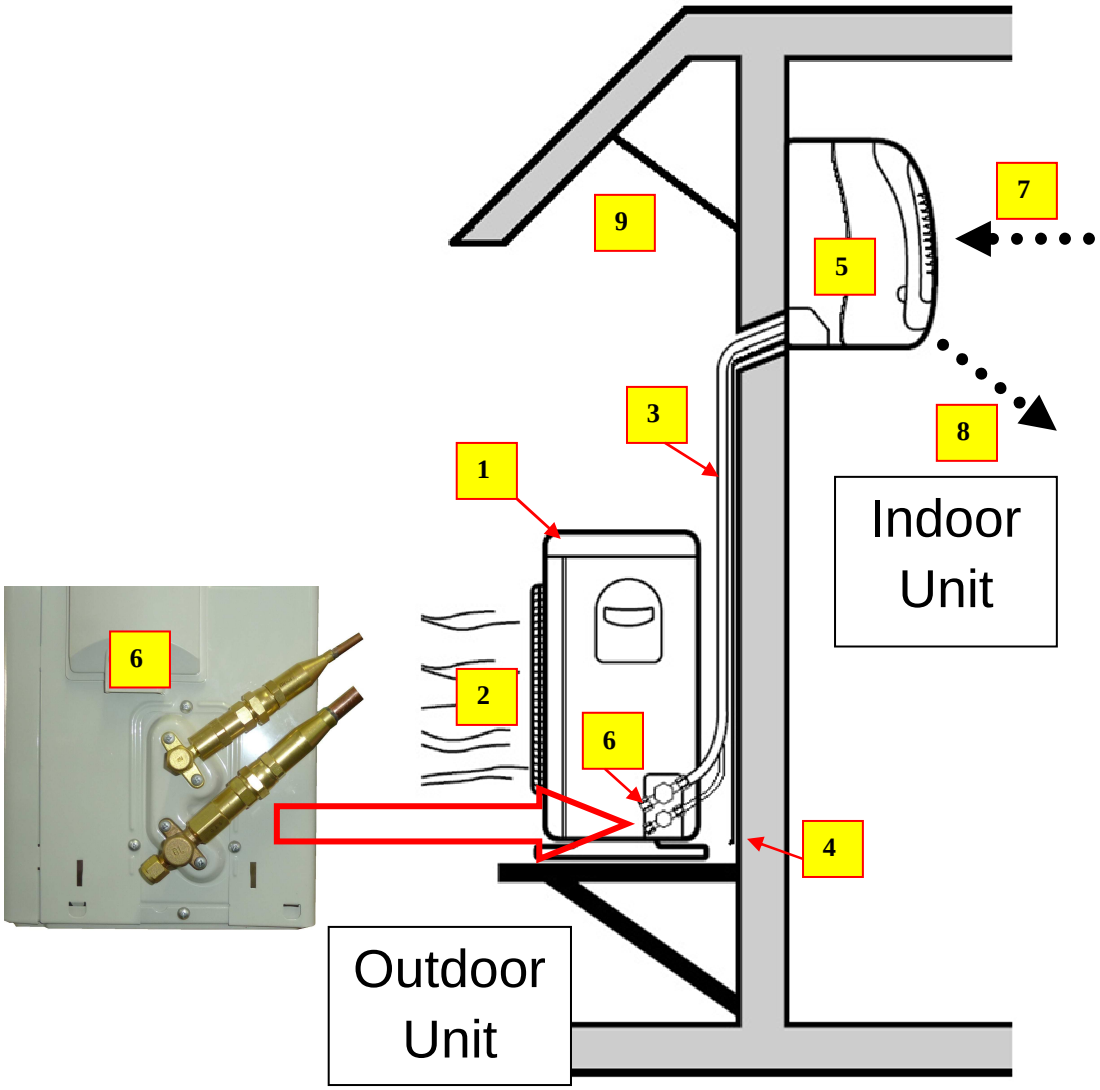
All components are pressurised and precharged with HC R-290 refrigerant!



The Outdoor Unit



Principle Installation Arrangement



1	Condensing unit	**2**	Condenser fan and air outlet	**3**	Refrigerant piping and electrical cable (pre assembled)
4	Drain pipe	**5**	Indoor (wall-mounted) unit	**6**	Quick coupler for refrigerant transfer tube connections
7	Air Inlet evaporator	**8**	Air outlet evaporator	**9**	Shadow zone for outdoor unit in-stallation

Tools, equipment and accessories

The following list is a description of the tools needed for installation. This list only mentions the minimum tools required for works including maintenance and service to the units.

Detailed list of tools and equipment including references and pictures, see page 130

Number	Item	Remarks
1	Toolbox	For sorting and storage of tools
2	Spirit level	To make sure that the mounting plate is installed horizontally
3	Safety gloves	For safe handling of the refrigerant and to protect the hands
4	Safety goggles	In order to protect the eyes
5	Drill	To drill holes during installation
6	Hammer, 300 gr.	For fixation of dowels
7	Measuring tape, 2 m	For measuring
8	Cable knife	To cut wires and adhesive tape
9	Set of screw drivers	To tighten the screws and the electrical wires
10	Set of electric pliers	To maintain electrical works
11	Combination wrenches set	Used for connecting the nuts.
12	1 adjustable wrenches	Used for connecting the valve's nuts and the pipe set.
13	1 torque wrench (200 Nm)	For tightening of the pipe set quick couplers
14	Allen key	To open and to close the stop valves at the outdoor unit
15	Leak detector (HC R290)	To detect gas leaks and for the use as PPE
16	Gauge set (HC R290)	To test and to check the system pressure after installation
17	Refrigerant hoses with ball valves	Gauge set connection and refrigerant transfer
18	Clamp-on meter	Test voltage, resistant and current.
19	Locking pliers	Sealing
20	Brazing unit, propane / oxygen	Brazing
21	20 Litre OFDN cylinder	Leak test, strength test, system flushing - 300/200 bar
22	OFDN pressure regulator	Cylinder pressure 0-315/200bar, working pressure 0-60/40 bar
23	Soap water solution and brush	Leak test
24	Portable thermometer	To measure air and contact temperatures
25	Two pin voltage tester	To measure and test voltage
26	Two stage rotary vacuum pump	To evacuate the AC system (rest removal of HC refrigerant)
27	Electronic vacuum gauge	AC system charging with refrigerant
28	HC R-290 refrigerant cylinder	Safe transport of refrigerant
29	Weighting scales	Reliable and accurate charge of HC R-290 refrigerant

Security advise for installation

During the installation activities, the installation site and the place of mounting needs to be ventilated well.

No unauthorised person should enter the installation area during installation activities

Do not close the doors or windows!

Do not use open fire, especially cigarettes, no brazing units or open cooking during installation.

Avoid static charge by wearing cotton clothes and cotton safety gloves.

Place the leak detector (or HC gas alerter/detector) operational in the installation area!

If there appears a leak within the refrigerant circuit increase the air ventilation at the installation side. Stop any work immediately and switch off the electrical power supply.

If damage occurs to the system during installation refer to the local service centre.

Switch off cell phones during installation. Take care that any other electric devices such as TVs, microwave ovens are switched off during installation.

For installation, service and repair always provide a dry powder fire extinguisher within the work area.

For this specific AC unit, the indoor room size should be at a minimum of 7 m² !

Before installation

The system contains exactly 200 grams of HC R-290 refrigerant charge. For security reasons the room for the installation of the indoor unit must have a minimum of room size. This is set to the system of GWH09AA-K5NNA6A at 7 m^2 minimum with 1.8 metre installation height. Refer to the room size selection table on the following page.

Assure yourself about the admissible minimum amount of room area before installation!

Before you unpack the system from the transport box, keep the HC leak detector ready.

Open up the transport box and produce only a small hole first into the foil in which the system is shrink-wrapped. Place the gas detector inside the wrapping and make sure that the detector does not identify the presence of any gas. Should there be a gas detection refer immediately to the local service centre in order to organise a replacement system.

Now unwrap the components.

Examine the delivered parts for damages.

Table of various installation height and resulting room size.

European standard EN378-1

International Standard IEC 60335-2-40

Installation height in meter	Minimum room size in m^2
HC R-290 Refrigerant Charge 0,200 kg	
1,80	7,0
1,85	6,6
1,90	6,3
1,95	6,0
2,00	5,7
2,05	5,4
2,10	5,2
2,15	4,9
2,20	4,7
2,25	4,5
2,30	4,3
2,35	4,1
2,40	3,9
2,45	3,8
2,50	3,6
2,55	3,5
2,60	3,4
2,65	3,2
2,70	3,1
2,75	3,0
2,80	2,9
2,85	2,8
2,90	2,7
2,95	2,6
3,00	2,5

The Installation Site - general information

The system should not be mounted at the following sites because of the existing danger of outer influences for a risk of malfunction or failure. In cases when installation to these sites is unavoidable, first contact the GREE Co. service partner.

1. Places with strong heat sources, combustible gases, vapours or volatiles
2. Places evoking high frequency waves, e.g. by radio equipment, medical or welding equipment
3. Places with an unusually high salt content in the air
4. Places with oil containing air
5. Places next to hot sources or geysers because of sulphite gases could be dissolved in the air
6. Any other places with specific but comparable conditions to those mentioned above. In case of any doubts refer to the manufacturer or to an authorised service centre.

The installation site – outdoor unit

1. Choose the installation location in a way that noise from the system or outgoing air from the system neither jeopardises nor bothers neighbours, animals or vegetation.
2. Make sure to choose an installation location which has free airflow (sufficient air volume) and is dry. Avoid direct sunlight or locations which are subject to strong winds.
3. Make sure that walls can stand the weight of the unit and can handle the associated vibration.
4. Consider the dimensions diagram (see page 58) during installation in order to achieve good accessibility for maintenance and services and to reduce the risk for material assets.
5. Mount the unit out of the reach of children.
6. Make sure that walkways are not blocked and that there are no negative influences to the skyline.
7. In case of any doubts refer to the responsible authority in the country where the installation is done.
8. In some countries special laws and restrictions for the mounting of split air conditioning units may apply.

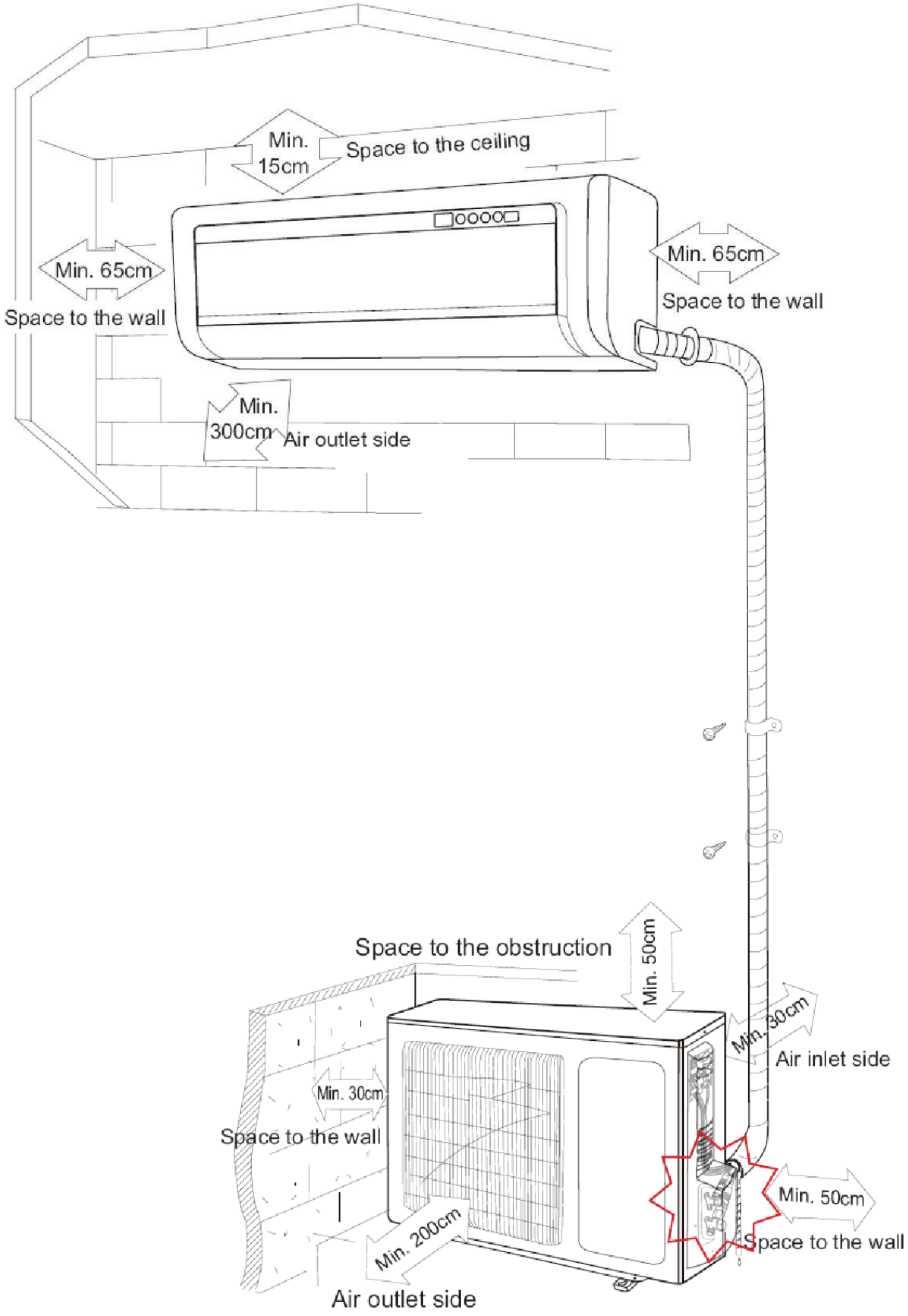
The installation site – indoor unit

Choose an installation site according to the dimensions (see page 58) diagram.

Modification of refrigerant transfer pipes is not permitted!

1. Make sure that condensate can flow out easily.
2. Keep in mind that the pre-installed pipe-set is exactly 5 m and no modifications are permitted (to shorten or to lengthen the refrigerant tubes) and that connections to the outdoor unit are easy to be set up.
3. Easy access to the indoor unit must be ensured for maintenance and servicing purposes such as a change of the filters.
4. The indoor unit should be mounted out of the reach of children.
5. Make sure that the installation position of the indoor unit can handle the weight of the unit and the associated vibration. At best no additional noise pollution should be generated.
6. Keep the unit away from heat sources, flammable and explosive materials.
7. The air inlet and outlet vent should not be obstructed, make sure that the air can be blown throughout the entire room.
8. There shall be no electric appliance, power switch or socket under the indoor unit.
9. There should be a minimum distance of about 1 m from TV-sets or any other electric appliances.

Installation Dimension Diagram



Installation Check List

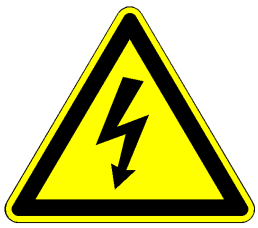
Carefully asses the local conditions and consider that all safety measures are in place. Check the needs for installation in order to arrange a smooth and uninterrupted work flow.

Remember, if you cannot work safe with HC refrigerants, don't do it!

In general, the GREE Hydrocarbon R-290 AC– Split System must be set up and configured to original factory specifications and tolerances!

No	Precondition for Installation	Remarks	Yes / No
1	Installation / Service person/s is qualified		
2	Installation / Service person/s carefully read and understood this manual		
3	The room size is no smaller than the limit in this manual (min 7 m²)		
4	Walls can handle the installation of indoor and outdoor unit		
5	No disruption to the environment		
6	There is no damage or leakage at the new AC components		
7	The set of AC components is complete		
8	Installation tools and equipment is prepared and in place		
9	Power connection (socket) at the right place		
10	Electrical installation is safe and according the local requirements		
11	Installation area is well ventilated		
12	There are no sources of ignition within the range of two metres		
13	Warning signs are placed		
14	Fire extinguisher is present		
15	Other persons in the area are informed about the activities		
16	Mobile phone is switched off		
17	Power socket of installation tools are more than two metres away		
18	HC leak detector is placed and in operation		

Safety measures concerning electrical equipment



Check the provided wiring diagram and verify with the installed AC– unit!

1. Electrical operations and installations are only allowed to be done by an authorised professional person according the local requirements and directives. Connect the air-conditioning system to a separate fused circuit.
2. Do not strongly pull the electric wires.
3. Any parts of the system must be integrated in effective equipotential bonding conductor connection. The unit needs to be secured against short circuit and overload.
4. Ensure a safe distance of at least 1.5 m to combustible materials.
5. Make sure any electric wires (live wire, neutral wire, protection earth wire) are installed to their specific function.
6. The wrong wiring leads to fire or damage of the system or even to an overheating of the wires.

Requirements for earthing

1. The system must be equipped with an effective equipotential bonding conductor connection.
2. The yellow-green wire is the earth wire and must not be used for other purposes at all. It is not allowed to cut the wire or to fix the wire with screws. Otherwise the risk of electric hazard increases.
3. Equipotential bonding / protection earthing must be done whilst obeying the local rules and regulations.
4. The earthing resistance must not exceed 4 Ohms. Otherwise an operation with combustible refrigerants is not allowed.
5. The connection to the circuit must be equipped with an earthing connection. Do not connect the earthing wire to water- or gas pipes or to other devices which would be pointed out as unsuitable by authorised personnel.
6. Earthing wires are not allowed to be switched. The earthing must be connected to the wall plug of the unit.

Miscellaneous

1. The wiring diagram of the required circuit wiring must be consulted during the connection of any kind of wires.
2. Before installation of the system ensure that existing laws and regulations of the local country regarding the wiring of air-conditioning systems and earthing are known. These rules and regulations are mandatory during installation.
3. The system is only for the operation done by children or persons with limited physical, sensory or mental abilities and persons who do not posses the required skills or experience. This group of people need to be supervised by a responsible person if the system is operated by these people.
4. The system is not a toy. Give advice to the end-user of no uncontrolled playing of children in order to avoid misuse of the system.

Procedure of the installation of the system

The following basic procedures must be observed for installation of the system:

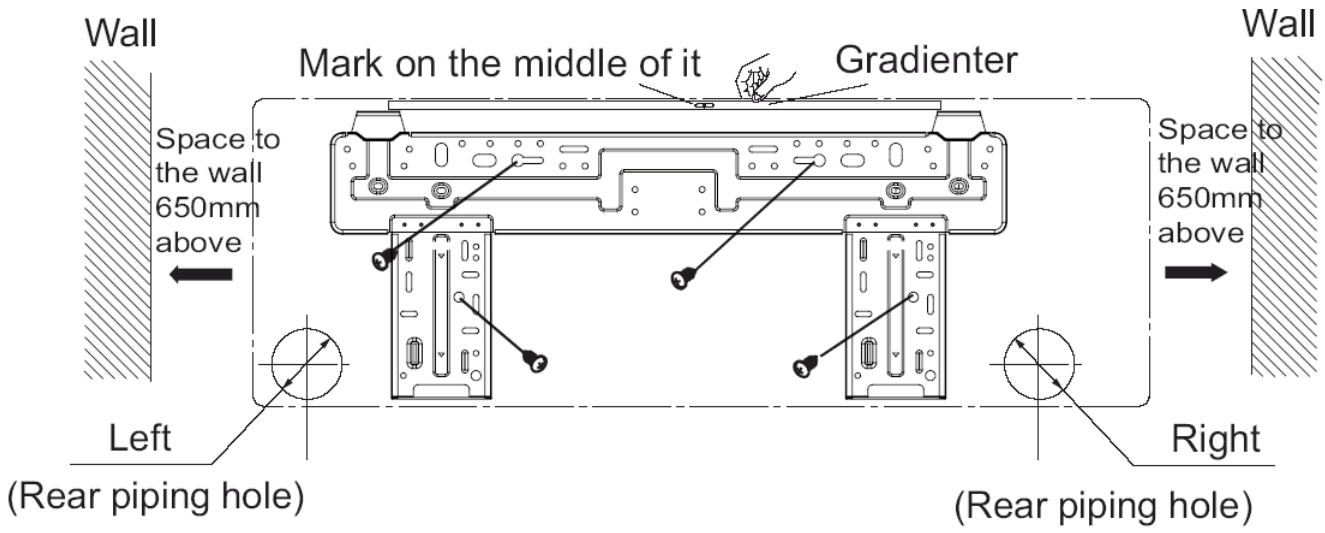
1. Read the specifications of the system and make sure that you understood them.
2. Make sure that the installation site meets the requirements.
3. Check the tools and equipment, especially concerning the suitability with R-290.
4. Accomplish the proper connection of the system.
5. Check the integrity of the system and check all the functions.
6. Hand over the end user manual to the client and instruct the operator about the basic functions of the system.
7. Fill in and sign the commissioning report (Start-up data sheet) provided on page 70 of this manual.

Installation of the indoor unit

After choosing a reliable installation site and a controlled check of the tools for mounting the system, start mounting the indoor unit.

The Mounting Plate

Install the mounting plate where the indoor unit will be placed.
Place the mounting plate horizontally, ensuring there is still a slight tilt in order to



make sure that condensate will run out unimpeded from the indoor unit.

Drill the holes and then fix the mounting plate by using dowels and screws. Pay attention to the way the wall is constructed at the chosen installation site. Make sure that the chosen screws and dowels are able to carry the weight of the indoor unit.

During drilling be aware of the possibility of existing supply piping such as water pipes or electrical wires.

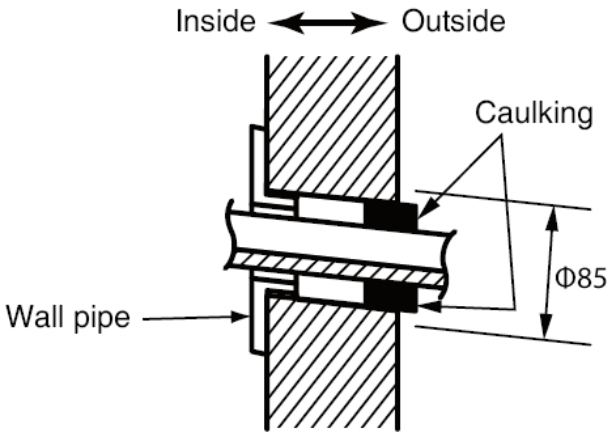
Make sure not to tighten the screws directly. Align the installation plate with a slight tilt only then tighten the screws. Be mindful of a strong and even contact with the installation plate to the wall. In doing so, vibrations and sound transmission is avoided.

Furthermore, pay attention to equal the weight distribution of the indoor unit to all screws.

Installation of connection pipes and cables

In order to connect the indoor and outdoor unit the connection pipes and cables (preinstalled and fixed to the indoor unit) need to be installed through the wall. Drill a wall duct of a diameter of at least 85 mm, with a slight descent through the wall of approximately 5% to the outside.

The hole must admit the refrigerant connection pipes, cables and condensate tube. All lines are covered with a common protective shell. Since the connection lines have a length of 5 m the lead through should be executed with the assistance of another person.



Indoor unit installation requires the assistance of another person!

Mounting of the condensate pipe

Make sure that the condensate pipe is always mounted with a natural descent to the outside, 5% descent is recommended. Furthermore make sure that the condensate pipe is neither bent nor kinked.

Both – bent and kinked – could obstruct the correct flow of the condensate. If it is not possible to realise, a descent, condensate pump must be installed.

If condensate is drained to the sewerage the condensate pipe must be equipped with a siphon in order to prevent a noise pollution or any other nuisance.

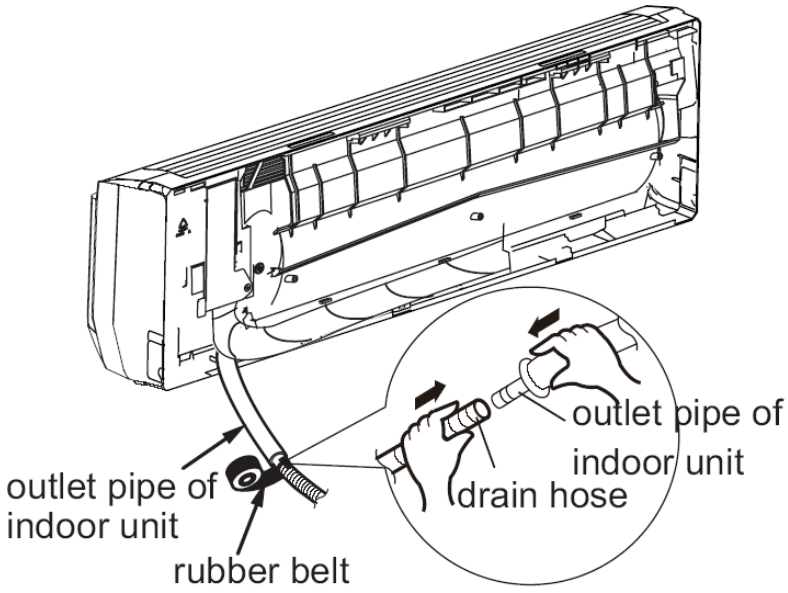
In case the outdoor unit is operated at low ambient temperatures or if the pipe may be subjected to ambient temperatures below 0ºC, condensate pipe must be protected against icing.

The condensate pipe must be isolated against water from condensation.

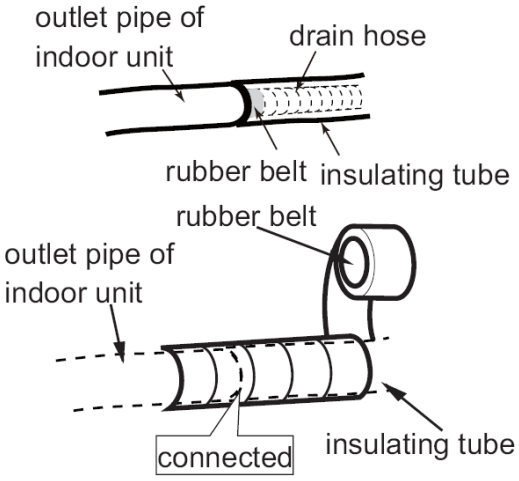
If condensate is drained to a storage container, the container must not be sealed. Otherwise back pressure will rise up and will therefore obstruct the correct flow of the condensate.

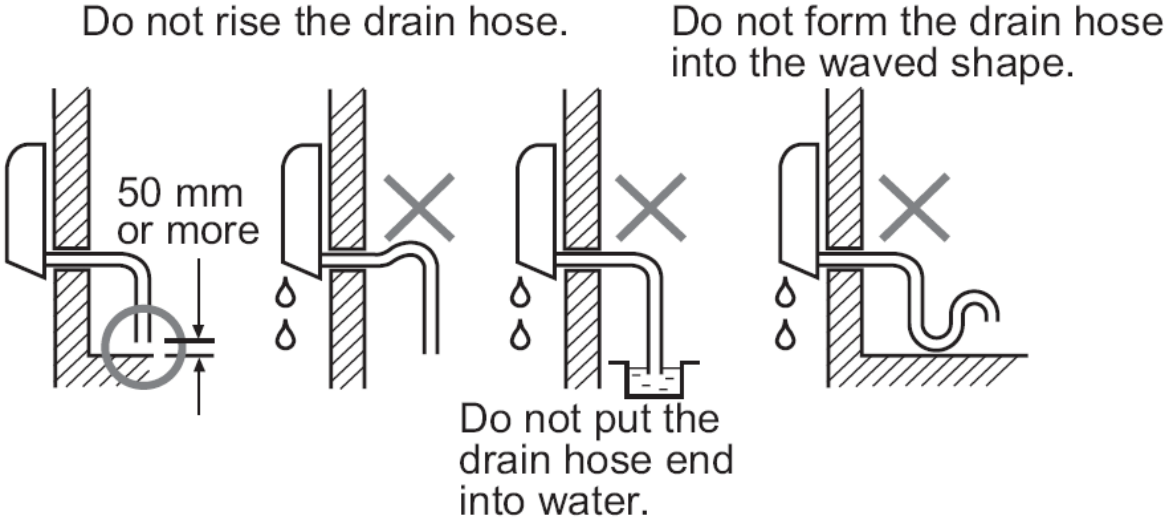
The end of the condensate pipe must not touch the maximum level of the condensate inside the container.

After installation the condensate pipe must be checked for density by testing the pipe with rinsing water.



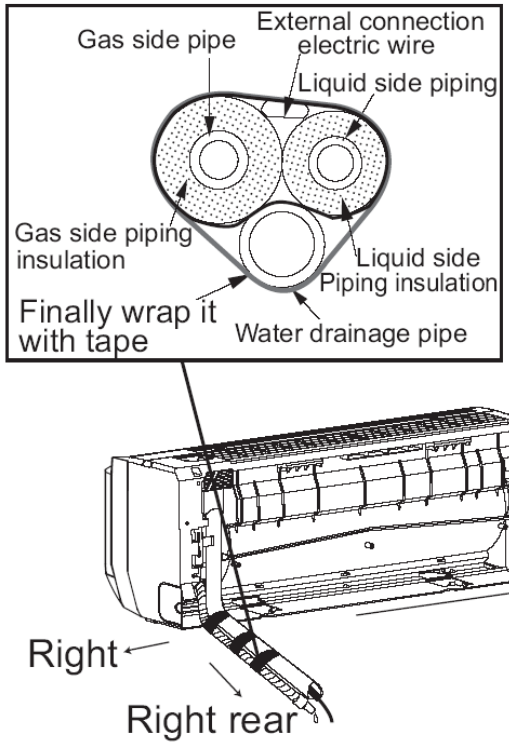
1. Connect the condensate pipe to the nozzle of the indoor unit. The connection must be fixed with adhesive tape.
2. Insert the condensing pipe into the piping-hole sleeve.
3. Lag the piping-hole sleeve with a wide adhesive tape in order to prevent it from moving.
4. Move the piping-hole sleeve together with the condensate pipe through the wall duct.





Running of connection pipe set

Refrigerant transfer pipes (liquid and gaseous refrigerant pipes) and the connection cables for indoor and outdoor units are bundled to one common pipe set permanently connected to the indoor unit.



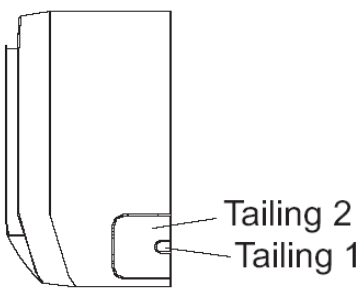
The unit is an INTRINSIC SAFE system! Refrigerant charge is limited to 200 gram

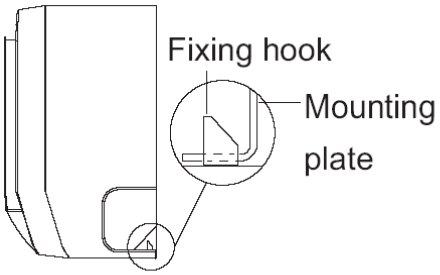
Top-up of charge is not permitted

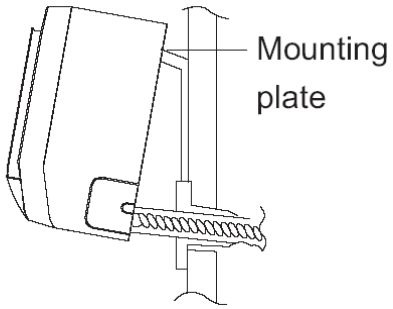
Modification of pipe-length is not permitted

The pipe set and the drain hose could be taken out of the indoor unit on the right and on the left side, as well as on the backside left, on the backside right.

1. If you want to lead the main power cable with socket from the right or from the left side cut off the tailings 1 on the operational side,
2. Cut off tailing 2 if you want to lead out both the main power cable, the indoor to outdoor connection wires and the refrigerant piping.







Hang up the indoor unit to the mounting plate and make sure that it is fixed tightly. After checking the installation, close the cable channel, which is located inside the wall by using operational resources such as plaster or mortar.

Installation of the outdoor unit

Consider the above-mentioned selection criteria when choosing the installation site and refer to the installation diagram because of the minimum distances to be kept for installation.

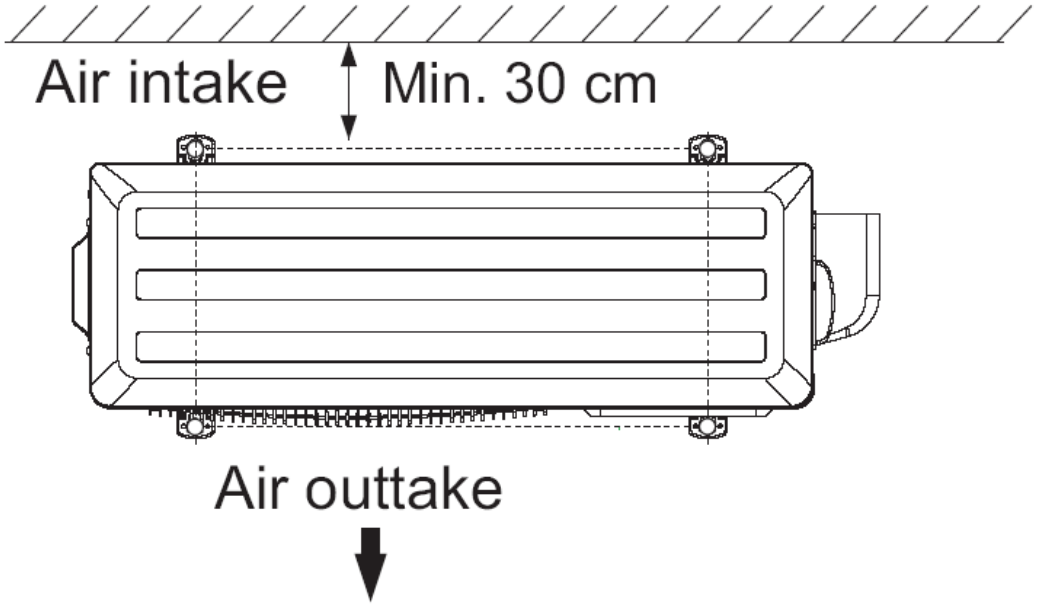
Mount the unit to solid ground, fix it securely and free of any vibration. Possibly use a shock absorbing substructure, such as a mounting bar.

For mounting the unit up to wall brackets, use specific heavy duty dowels (and special screws) in accordance to the consistency of the wall. Use vibration dampers to prevent a transmission of oscillations and vibrations from the unit to the wall.

Make sure to mount the outdoor unit with a maximum descent not exceeding 3°. In any case make sure – when there is an unavoidable descent – that the compressor is not located inside the deeper laying part of the unit.

The distance of the outdoor unit to the wall shall not be less than 300 mm. Keep in mind that no exhaust air (warm air) from other installations shall enter the outdoor unit.

Furthermore make sure that the outdoor unit is mounted tightly enough in order to resist strong winds. In areas with a large amount of snow it is recommended to place a roof above the outdoor unit.



Interconnection of indoor and outdoor unit

Consider the following remarks when interconnecting the functional pipe set:

Modification of refrigerant transfer pipes is not permitted!

Install the functional pipe set carefully and protect it against movement. Make sure on behalf of the construction side that no tractive forces can arise. Under no circumstances shall the piping by modified.

The wires must be connected correctly. A wrong connection could lead to damages of the system. A wrong connection of the earthing wire could lead to serious health damage caused by electric shock. Connect the wires securely and reliably. Check the stability of the connection. Check wire screws in case of loosening during transport. Avoid any damage to the wiring.

Make sure that the plate of the housing and the connections are tightly closed. This needs to be done in order to prevent mist or humidity from entering. Otherwise this would lead to short circuits or fire.

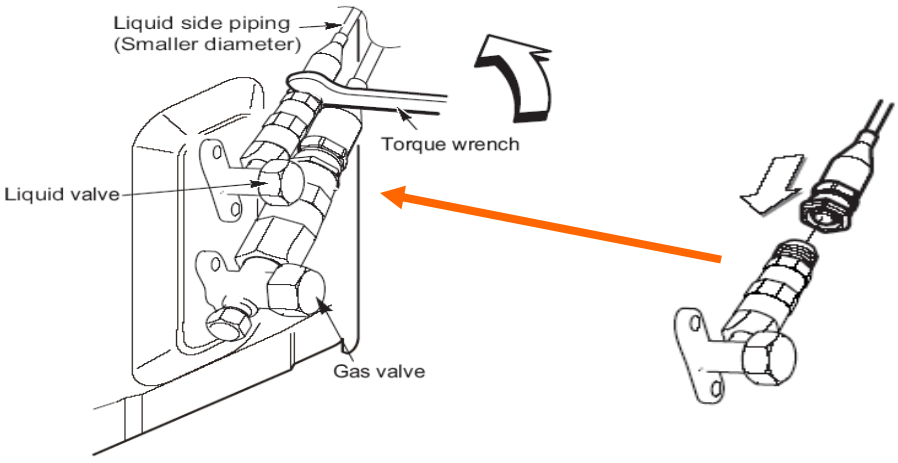
Do not exceed the maximum torque of the connection in order to avoid leakage.

Make the connection of the refrigerant piping as mentioned below:

1. Remove the valve cover from the outdoor unit.
2. Remove the rubber plug from the valve.
3. Remove the sealing cap from the pipes.
4. Adjust the connection pipes.
5. Connect the female connector of the pipes to male connector of the unit.
6. Tighten all fittings with torque wrench and open-end spanner.
7. Obey strictly the tightening torques in the chart listed.
8. Open the gas valve and the liquid valve with an Allen key.
9. Check all mechanical joints by an electronic gas detector for leakages (refer to further information on page 88 of this document).
10. Connect the electrical wiring between the indoor and outdoor unit and affix them by using a cable strap, so that the connection cannot shift.

First Leak-Check at interconnected components!

Mechanical Connectors at Pipes with	Tightening torque (Nm)
¼”	14 to 18
⅜”	34 to 43
½”	49 to 61
⅝”	68 to 82



The Quick-Coupler Valves

To interconnect the Pipe-Set for refrigerant transfer (liquid-line and suction-line) Quick-Coupler are used. All parts used for AC system assembling are pre-charged with pressurised refrigerant R-290. The release of refrigerant is practically not possible during the correct connection of the quick coupler.

For leak free connection of the pipe set to the outdoor unit valves in total four (4) mechanical connections have to be tightened!

Advantages with the use of quick-coupler:

- Fast and easy connection of liquid– and suction line in fixed installation from the evaporator to the valve assembly of the outdoor unit.
- Durable gas tight interconnection.
- Repeated interconnection is possible (placing of the AC unit at another suitable installation place).

The valve and quick-connector assembly consists of:

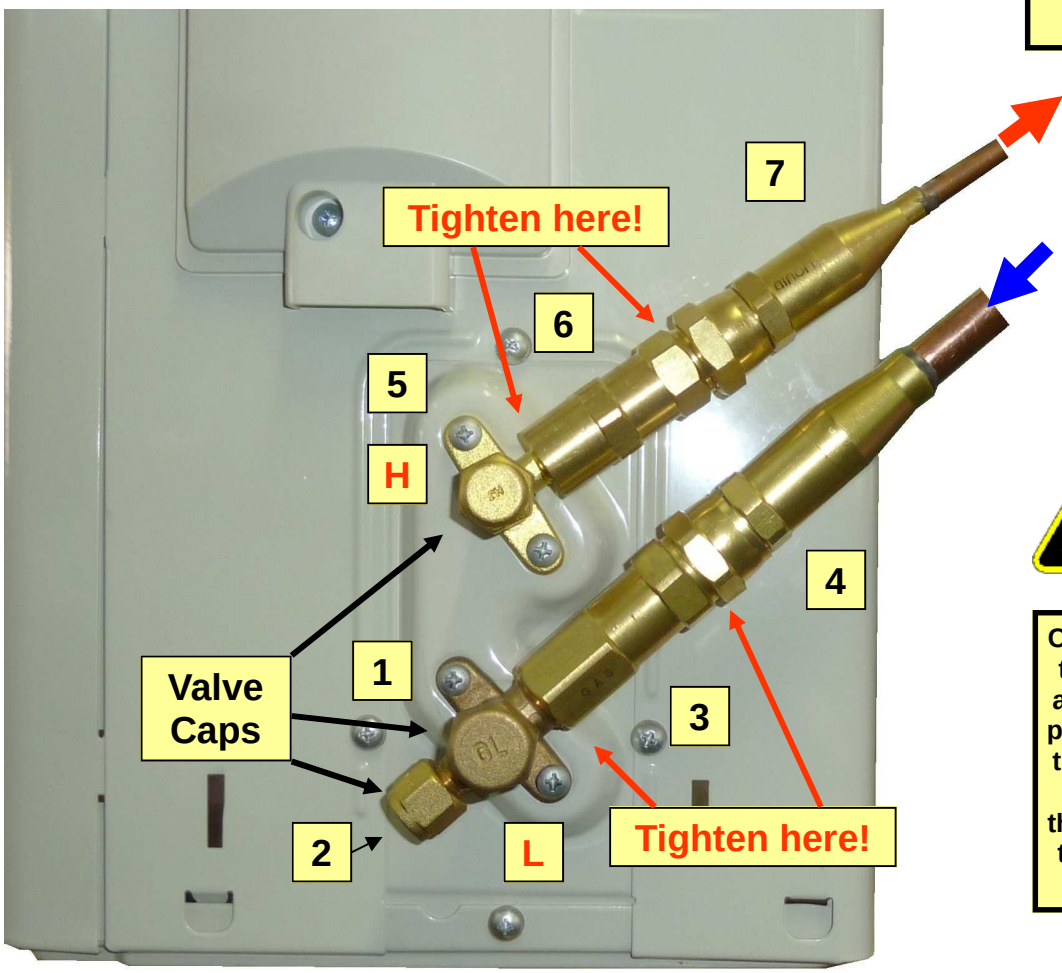
Suction Line (L)

1. Stop valve at outdoor unit (stem to be activated by Allen-key) with ½" SAE connection.
2. Service port 1/4" SAE connection with internal Schrader valve .
3. Male Quick-Coupler part—valve side
4. Female Quick-Coupler part—Suction line side with ½" pipe joint.

Liquid Line (H)

5. Stop valve at outdoor unit (stem to be activated by Allen-key) with ¼" SAE connection.
6. Male Quick-Coupler part—valve side
7. Female Quick-Coupler part—Suction line side with ¼" pipe joint.

With final commissioning of the system all theses mechanical connections are subject to a leak check with appropriate leak-detector!



Carefully mount the valve caps and the service port cap back to the stop-valves and include these spots into the leak-check activities!

Commissioning

Checks before commissioning

Before the AC split system commissioning any installation work on the indoor and on the outdoor unit must be finished completely.

For the first time activation make sure that the following working steps listed below are complete:

1. The outdoor unit is mounted securely and tightly screwed in order to prevent vibrations during operation. The fixing ground is stable enough in order to carry the weight of the unit.
2. The wall penetrations are filled and tightened with moisture-resistant insulation and sealed professionally.
3. The earthing wire has been checked.
4. The water drain hose (condensate) is mounted correctly.
5. The surrounding area nearby the indoor and the outdoor unit is free such that neither the air intake nor the air outlet is obstructed.

Refrigerant circuit

The outdoor unit is prefilled with the refrigerant HC R-290. The filling quantity conforms to the necessary filling of the indoor and outdoor unit, as well as for the functional pipe set and is strictly limited to the labelled amount.

First operation of the system

The first operation of the system is done under supervision of a trained and competent person. This is to ensure that all installation activities are made properly, that the system is wired correctly and that the unit operates with the intended performance.

1. Ensure that any tools and installation debris are removed from the units.
2. Switch on circuit breakers after the installation is completely finished.
3. Check the correct connection and the electrical wiring once again.
4. Make sure that all valves are opened.
5. Switch on the system for first operation. Press the “ON/OFF“ button of the remote control in order to start the unit.
6. By pressing the “MODE“- button switch the system through the different modes of operation: COOL, DRY, FAN in order to find out about the correct operation of the unit in all modes.
7. Check the system operation for at least 15 min.
8. Afterwards, check the indoor and the outdoor unit for the following aspects mentioned below:

Indoor unit

1. Activate all buttons of the remote controller and confirm that they evoke the requested effects (compare pages 27 to 30)
2. Confirm that all lights and displays operate.
3. Confirm that the actuating drive of the air-flow louver operates properly.
4. Confirm that condensate drains without any obstruction.
5. Measure the entering-air and the leaving air temperature of the indoor-unit with start-up and at the end of the 15 minutes test.
6. **Finally the measured temperature difference across the indoor unit air inlet and air outlet should be at about 8 K.**

Outdoor unit

1. Confirm that there is no anomalous noise or vibration (other than the normal known working conditions) during operation.
2. Check the refrigerant circuit: Connect a low pressure gauge with a refrigerant hose to the 1/4" SAE service port of the outdoor unit. Confirm that the female 1/4" hose connection provides a correct adjusted core-depressor to enable the opening of the "Schrader-valve" inside the service port.
3. Measure the suction pressure: the suction pressure must be within a range of 4 to 6 bar (gauge pressure). The system must not be operated outside the normal running parameters. If it is found that the measured values differ from these value, it may indicate a malfunction of the system or indicate a deficit of refrigerant.
4. Search for leakage with an electronic gas detector.
5. After several seconds, close the liquid valve at the outdoor unit in order to pump the refrigerant to the high-pressure side of the system (pump-down). This will enable the disconnection of the low-pressure gauge and hose from the low-pressure valve of the outdoor unit without loss of refrigerant. Check the pressure of the LP gauge; if the pressure is at 0 bar or slightly above, remove the gauge with the hose from the LP stop-valve.
6. Open the stop-valve at the liquid side of the system again.
7. Put back again the sealing caps to the valves and the service port.
8. Finally, carry out the search for refrigerant leakage.

After switching off the system, check for the electrical insulation resistance. Regardless of any other national laws and requirements, the resistance of the live and neutral wire must be above 7 MOhm.

9. Install the valve cover back to the housing of the outdoor-unit.

Make sure leak checking is done on the suction side of the unit without operation of the unit. In contrast check for leaks to the liquid side whilst the unit operates.

Because!

Suction pressure is higher at the low pressure site of the system in "Off" position!

Pressure at the liquid stop-valve is higher under operational conditions of the system.

Leaks are better detected under higher pressure.

Handing over the new system to your client

The client must be comprehensively instructed on the operation and the functions of the system, as well as the handling of the remote control. Show to the client the relevant pages of the users' / operators' manual where they will find suitable and specific information.

Handover the operation manual to the client, as well as this instruction manual.

Request that the client keeps the technical data sheets and all instruction manuals nearby the unit.

For the documentation of the system commissioning and clients instruction, use the "Start Up Data Sheet" report placed on the following page.

Fill the "Start Up Data Sheet" report, sign it and hand it over to the client!

Start Up Data Sheet for GREE Split Air-Conditioner	
Installation Company	
Address	
Telephone & Fax	
Technician Name	
Registration No.	
Client / Company	
Contact Person	

Installation / Appliance DATA	
Model and No.	
Date of Installation / Repair	
Comments / Repair	

Operating Data – Cooling Mode		
Refrigerant Type	R-290	
Refrigerant Name	Propane	
Refrigerant charge	0,200 kg	
Suction Pressure P1		
Suction Temperature equivalent P1		
Air Temp. Entering Condenser T3		
Air Temp. Leaving Condenser T4		
Air Temp. Entering Evaporator T1		
Air Temp. Leaving Evaporator T2		**Flammable Refrigerant**

<u>Performance Test:</u> With appliance commissioning please operate the split– air conditioner with HIGH indoor fan speed in mode COOLING for a minimum of 15 MINUTES. Measure air inlet (T1) and air outlet (T2) temperature at the indoor unit. The temperature difference should be at least 8 K.

Electrical Data	
Power Supply (Voltage)	
Overall Ampere Reading	
Current draw Compressor	

Other executions for system commissioning!	Tick box for completion
Only use correct and reliable tools / equipment for system commissioning!	
Functional AC system check including performance test!	
Check the AC system for refrigerant leakage!	
Check that electrical connections are tight!	
Check that condensate drain is tight and with down-grade!	
Check insulation of refrigerant transfer tubes and quick-coupler!	
Check free run of condenser and evaporator fans!	
Check system operation (indoor/outdoor) on abnormal operational noise!	
Clean system components including air filter (if indicated)	
Check display of the remote controller!	
Execute briefing of the AC system user!	

Company signature and date:	Client signature and date:

Service, Repair and maintenance

A permanent stand-by, the reliability of the system and the expected system efficiency requires a regular preventive maintenance and professional service to minimise the possibility of malfunction. The annual preventive maintenance and any required service should be done by a specialised company and personnel only (competent person).

For the required tools please note the chart on pages 130 to 134.

Directives for service and maintenance

1. Carry out any service or maintenance to the system only if the working area is well ventilated. Make sure that windows and doors are open.
2. Do not use open fires and remove any source of ignition away from the installation/work site. (2 m safe distance is recommended).
3. Do not use cell phones during maintenance and advise other attendees not to use open fires or cell phones.
4. Take precautions to avoid static charges. In order to do so wear e.g. cotton clothing and protection gloves made of cotton.
5. Should it be demanded to leave the room during maintenance – for example in order to get spare parts – make sure that no unauthorised persons enter the room during your period of absence. Use appropriate signs.
6. Make sure of a correct grounding during maintenance as demanded by regulations.
7. In case of transporting the refrigerant cylinders, assure yourself that the cylinder pressure is not above the allowed pressure.
8. Place cylinders only in an upright position and make sure that the cylinder is not placed nearby heat or fire sources, sources of radiation or electric devices.
9. In exceptional cases, it might be necessary to dismantle the system and to bring it to an authorised service centre.
10. However, all services could be done to the unit locally.
11. Become familiar with the operation of a gas detector. Leave it turned on in the immediate working area during maintenance in order to get an early warning about leaking gas.
12. Before beginning maintenance ensure sufficient security- and emergency measures are provided and ready for operation.
13. Ensure an appropriate fire extinguisher (CO_2 or dry powder) is ready for use.

Regular Annual Preventive Maintenance

In general the regular and preventive maintenance is limited to cleaning activities and to scrutinise the system functions and parameters. This is to verify that the system is operating in safe condition and with expected efficiency. The following procedures describe how to carry out professional maintenance of the HC R-290 air-conditioner.

Required maintenance of the indoor unit

1. Examine the fan for functionality and smooth running.
2. Carefully clean the air-filter, if necessary use a shower bath with hand-warm water.
3. Check the heat-exchanger (evaporator) for contamination, if necessary clean the evaporator (water and/or evaporator cleaning solution).
4. Check the alignment of the evaporators fins, if necessary carefully adjust the alignment by the use of a fin-comb
5. Check and clean the condensate pan and drain hose
6. Check the control board (mode and temperature indicators)
7. Check the connection cables, wires are free of damage and screws are tight.
8. Check the remote controller for functionality.
9. Clean the housing of the indoor unit.
10. Verify the specific condition according the provided checklist with page 73.

Servicing the outdoor unit

1. Examine the fan for functionality and smooth running.
2. Examine the compressor for functionality and smooth running.
3. Check that the fixings and vibration dampers of the compressor are in good condition.
4. Check the heat-exchanger (condenser) for contamination, if necessary clean the condenser with OFDN
5. Never use refrigerant for cleaning of the heat exchanger.
6. Check the alignment of the condensers fins, if necessary carefully adjust the alignment by the use of a fin-comb.
7. Check the connection cables, wires are free of damage and screws are tight.
8. Check the operational conditions of the refrigeration system.
9. Clean the housing of the outdoor unit.
10. Verify the specific condition according the provided checklist with page 102.

Refrigerant circuit

Examine the refrigerant circuit and check that it is free of leaks by using a HC gas detector, which is reliable and safe for use with HC refrigerant R-290. Pay particular attention to the connections of the pipe-set between the indoor and outdoor unit, as well as to the brazed joints and mechanical connections. Verify that all refrigerant transferring pipes are free of vibration and do not touch each other (friction).

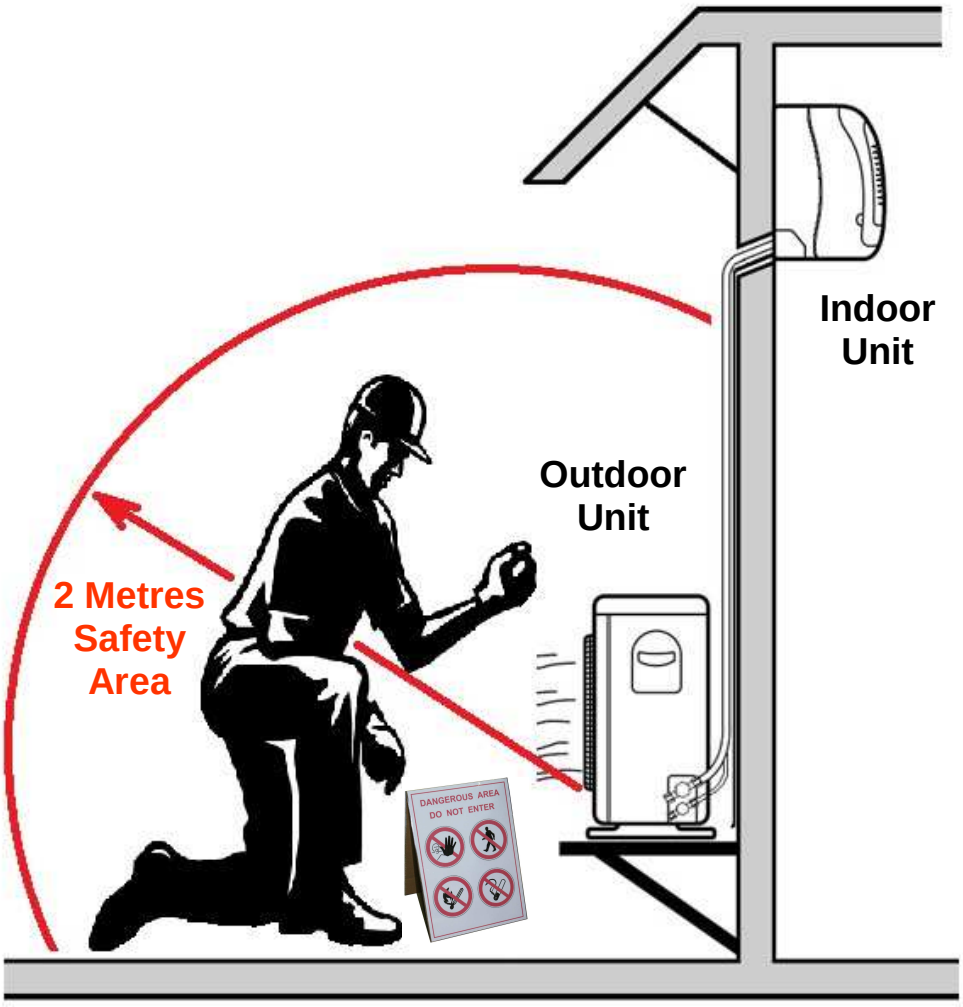
If repair or system service is necessary (in specific, if an intervention into the refrigerant circuit is indicated), required activities have to be carried out with due care and according to the advices described with the "Service, repair and maintenance" section (beginning on page 71) of this manual. Always wear your individual protective devices!

Maintenance Checklist R-290 AC				
Assembly group	**Repaired**	**Replaced**	**Cleaned**	**Value / Remark**
Indoor unit				
Surface heat exchanger				
Evaporator fins				
Condensate pan and drain hose				
Air filter				
Fan, motor and smooth operation				
Indoor air temperature ℃				
Intake				
Outlet				
Outdoor unit				
Surface of heat exchanger				
Condenser fins heat exchanger				
Fan, motor and smooth operation				
Housing				
Outdoor air temperature ℃				
Intake				
Outlet				
Compressor				
Compressor fixing and dampers				
Operational noise				
Drawn current				
Refrigerant discharge temperature ℃				
Ref. suction gas temperature ℃				
Suction pressure (bar)				
Refrigerant circuit				
Leak tightness				
Vibrations of pipes				
Friction of pipes				
Control system and electrics				
Remote control				
Cables and wiring / fixing, friction				
Wiring – screws tightness				
Temperature sensors				
Relays or other electr. components				
Miscellaneous				
Labelling oft he system				
Availability of documentation				
Any clients complain				
Signature of technician			Date:	

Safety Work Area and Temporary Flammable Zones

When working on systems using flammable refrigerants, the technician should consider certain locations as “temporary flammable zones” (see also page 75). These are normally regions where at least some emission of refrigerant is anticipated to occur during the normal working procedures, such as recovery, charging, and so on; typically where hoses may be connected or disconnected.

In general, the work schedule for refrigerant handling during service and repair activities, should be arranged in a manner that the release of refrigerant is not necessary (e.g. “pumping down“ the system and moving the refrigerant charge to the high site of the system). In anticipation of the maximum quantity of refrigerant that may be released during such a procedure (such as disconnecting a hose whilst it is full of liquid refrigerant), the minimum distance in all directions and with respect to the occupied working area where the service equipment is placed, should be a minimum of two metres.



Strategically plan your work schedule and create a SAFTY WORK AREA of a minimum of two (2) metres!

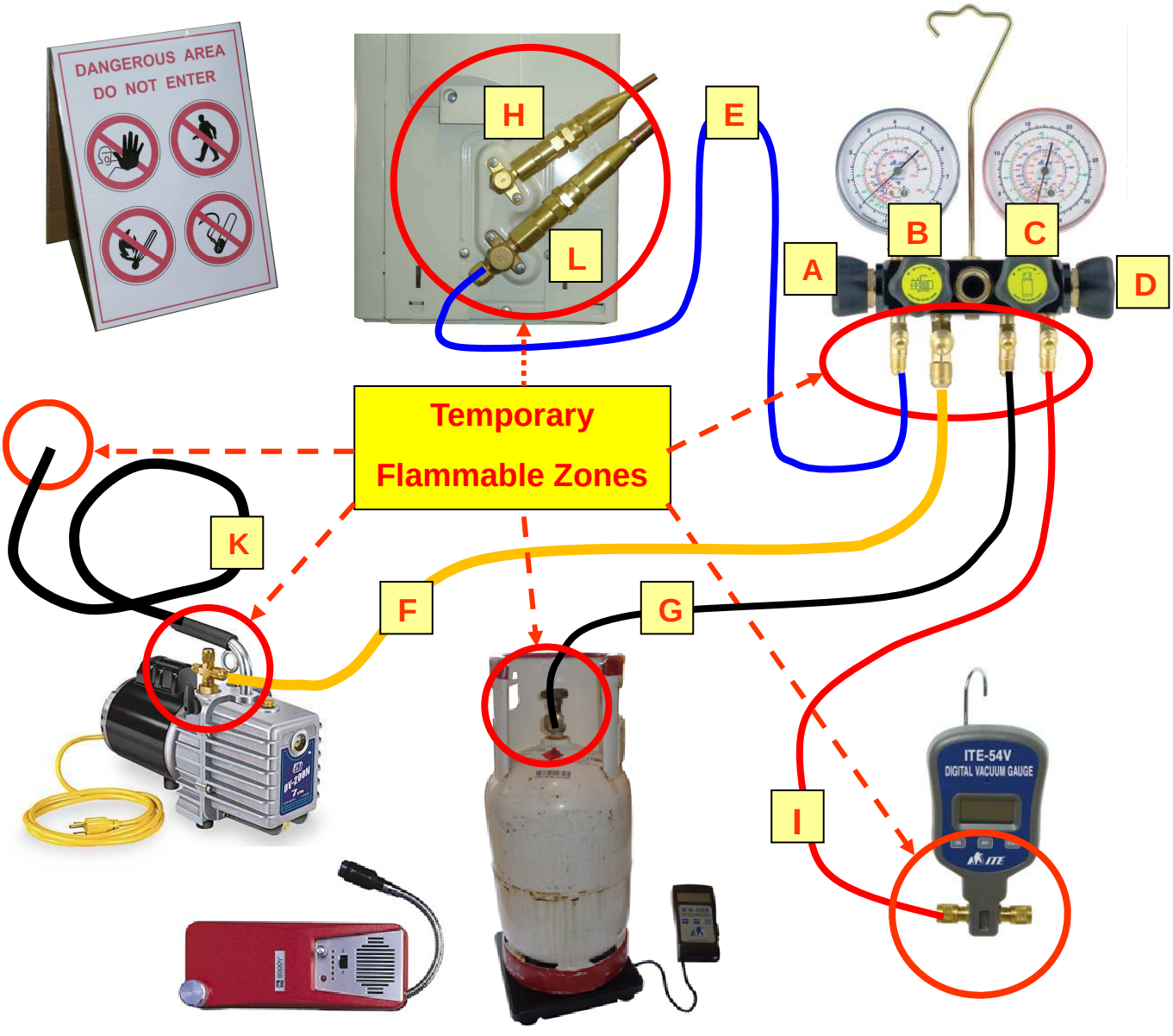
The two (2) metres safety working area is in case of any accidental release of refrigerant that forms a flammable mixture with air!

For any reason and under specific circumstances where service or repair activities have to be carried out on the indoor unit (breaking into the refrigerant carrying system), the designated two (2) metres safety area will apply the same way as indicated for the outdoor unit!

Arrangement of Equipment and Tools

The drawing below indicates the arrangement of equipment and tools for service work where flammable refrigerant can be present. The interconnection with refrigerant transfer hoses is also shown. Capital letters designate the specific valve or refrigerant hose. Within the following pages are these letters again in the course of activity sequences to be carried out for specific service activities like charging of refrigerant or evacuation of the system. If specific valves have to be activated or refrigerant hoses to be connected, the letter indicates the position in the diagram for reviewing and better understanding.

	Valve		Refrigerant Hose
A	Manifold Low Pressure Gauge	E	Connection Hose A > L
B	Manifold Vacuum Pump	F	Connection Hose B > Vacuum Pump
C	Manifold Refrigerant Cylinder	G	Connection Hose C > R-290 Cylinder
D	Manifold (Vacuum Gauge)	I	Connection Hose D > Vacuum Gauge
H	Outdoor Unit Liquid Side (High)	K	Vent Hose 5 m length ½" (12 mm) inner diameter
L	Outdoor Unit Gas Side (Low)		



Refrigerant Venting

In order to open the refrigerant cycle (for any repair, replacement of parts and subsequent brazing or tube joining with pressing connections) the total R-290 refrigerant charge has to be removed from the system.

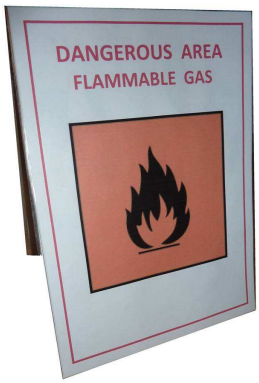
Venting can be carried out as an alternative to recovering the refrigerant. If venting is considered, it should be done in accordance with the relevant national laws.

Normally, venting is only carried out with systems that contain a small quantity of refrigerant, larger quantities should be recovered.

If venting is to be carried out, a set of special procedures is required to ensure that it is done safely, by following the general safety procedures and through appropriate use of a suitable hose.

Important Notes!

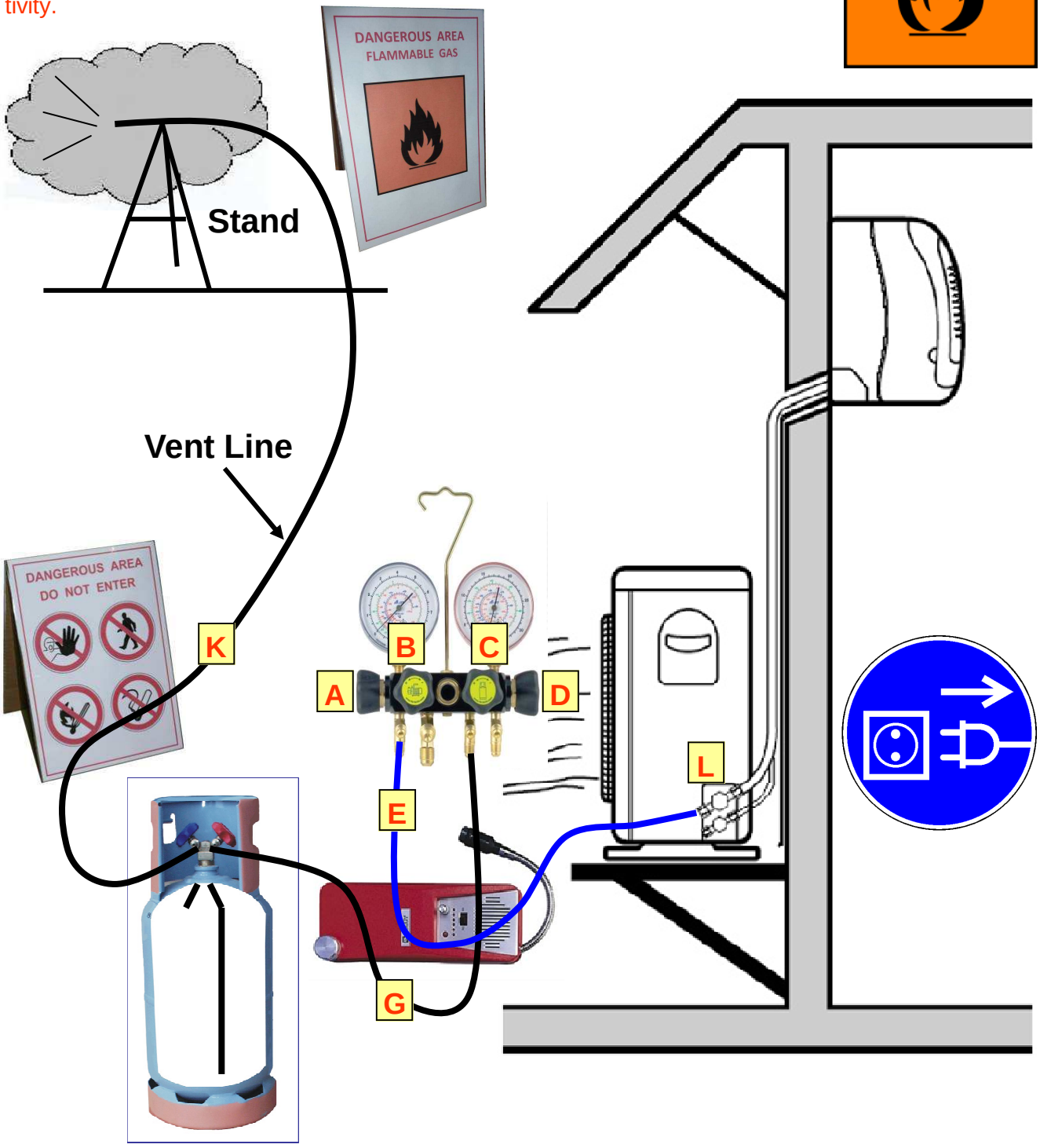
1. Venting inside a building is not permissible under any circumstances.
2. Venting must not be to a public area, or where people are unaware of the procedure taking place.
3. The hose must be of sufficient length of about a minimum of 5 m
4. The hose should have a minimum of 12mm (½") internal diameter
5. Venting should only take place on the certainty that the refrigerant will not get blown back into any adjacent buildings, and that it will not migrate to a location below ground level
6. The hose is made of material that is compatible for use with HC refrigerants and oil
7. A device is used to raise the hose discharge at least 1 m above ground level so that the discharge is pointed in an upward direction (to assist with dilution)
8. Close to the inlet of the hose, an oil separating device is fitted to present the emission of refrigeration oil, so that it may be collected and disposed of properly following the venting procedure (a recovery cylinder may be used for this)
9. There must be no sources of ignition near the hose discharge
10. A flammable gas warning sign must be positioned close to the hose discharge
11. The hose should be regularly checked to ensure that there are no holes or kinks in it that could lead to leakage or blocking of the passage of flow
12. When carrying out the venting, the flow of refrigerant should be metered using manifold gauges to a low flow rate, so as to ensure the refrigerant is well diluted.
13. The venting process has to be monitored for the entire time.
14. Once the refrigerant has ceased flowing, the system must be flushed out with OFDN; if not, then the system should be pressurised with OFDN and the venting procedure carried out two or more times, to ensure that there is minimal HC refrigerant remaining inside the system.



Refrigerant Venting—Part 1

Connect the manifold gauge as indicated below to the service port of the outdoor unit. LP valve port “A” enables to vent the HC refrigerant at a low flow rate in an easy-to-control manner. The venting of the HC refrigerant takes place via a two-valve access port equipped recovery cylinder, which will act in this specific case as an oil separator. The vent-line is connected at the gas valve of the recovery cylinder. The release of refrigerant transfers lubricant from the outdoor unit will now remain in the recovery cylinder. The end of the 5 m vent-line is placed on about 1 m high stand to ensure better dilution of HC refrigerant in air during the venting process.

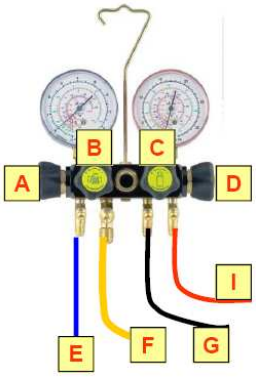
A flammable gas warning sign must be positioned close to the hose discharge port to indicate that there is an occurrence of flammable gas during venting activity.

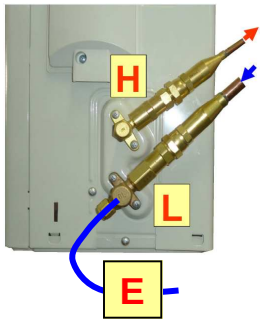


Recovery Cylinder with 2-Valve access

HC Refrigerant Venting—Course of activities sequences 1

Section – Refrigerant Venting		
Steps recommended for part 1		
No	**Where**	**Activities**
1		Carry out all intended works without hurry and **THINK BEFORE ACTING!**
2		Arrange your tools, manifold and equipment connections as indicated on page 77
3	**A, B, C, D,**	Manifold gauge valves “closed”
4		AC system “OFF“ (unplugged)
5		Place a warning signboard in front of your work area and at the end of the vent-line to indicate that flammable refrigerant gas will be vented to the environment and that no unauthorised people may enter the safety work area.
6		Smoking and open flames are prohibited.
7		No other sources of ignition must exist within this area (including your cell phone).
8		Place your HC leak detector on the floor close to your tools arrangement. Switch on the leak detector. If HC refrigerant is detected you will hear the warning signal.
9		Inform other individuals about the safety measures and your projected time span to maintain all service activities.
10		Assure that all other necessary service tools and spares for the intended job are in place.
11		Confirm that the circumstances for the intended job are safe.
12		Provide a hose with a length of a minimum of 5 metres (actual needed length will be according to installation site condition) and an inner diameter of a minimum of 12 mm.
13	**E, L**	Assure that the refrigerant transfer hose with the connection at the suction line service port “L” consists of a core depressor to open the service port inner core valve during connection.
14	**K, G**	Interconnect the **EMPTY** recovery cylinder with manifold and vent-line. The refrigerant hose G must have access to the liquid port of the cylinder (dip-tube) and the vent-line K to the gas port of the cylinder. This connection enables oil to be separated in the cylinder during refrigerant venting process.
15	**L**	Open the suction side stop valve at the outdoor unit and both valves of the recovery cylinder.
16	**A, C**	Open valves at manifold gauge set. Refrigerant starts venting and the flow of refrigerant can be easily and safely controlled by operation of valve A.
17		This process should be carried out until no flow of refrigerant is determined. Pressure at A, C is Zero.
18	**A**	Close the low side valve A at the manifold gauge set.





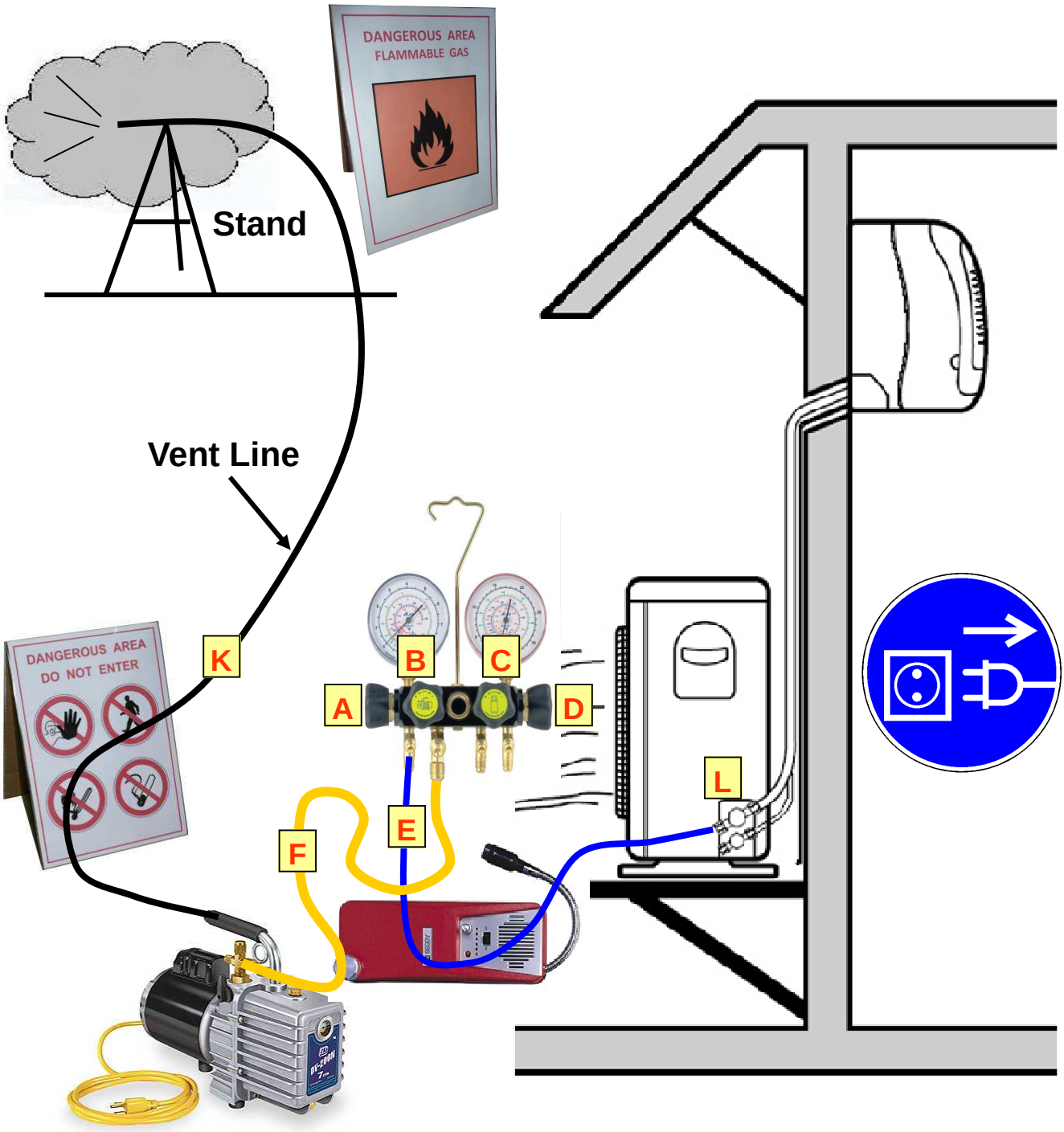
Consider that the service port of the suction side stop valve is equipped with a Schrader valve.
Hose connection must have an adjusted core-depressor to open the Schrader valve core correctly!

For safe venting of HC refrigerant and Oil-Separation an EMPTY recovery cylinder is needed!

Refrigerant Venting—Part 2

After determining that there is obviously no flow of refrigerant venting from the outdoor unit, a proportionally high residual amount of HC refrigerant is absorbed within the compressor lubricant and left in the system. To empty the system from residual HC refrigerant as much as possible, a vacuum pump should be connected to the system. Disconnect the recovery cylinder (oil-separator) from the system and install the vent-line to the exhaust port of the vacuum pump. The free end of the vent-line remains on the stand as described on the previous page of this section. Lowering the pressure in the system, the residual refrigerant absorbed within the lubricant starts evaporating and gets transferred with the vacuum pump and vent-line to the ambient.

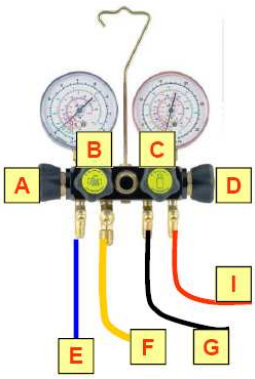
A flammable gas warning sign must be positioned close to the hose discharge port to indicate that there is an occurrence of flammable gas during venting activity.

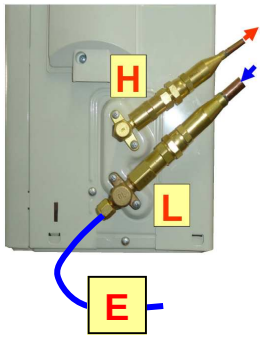


HC Refrigerant Venting—Course of activities sequences 2

Section - Refrigerant Venting		
Steps recommended for part 2 - use of vacuum pump		
No	**Where**	**Activities**
19	**K**	Close gas and liquid valve of the recovery cylinder. Disconnect the vent-line from the gas port of the recovery cylinder (oil-separator) See sequence 1 from page 78.
20	**G, C**	Remove the refrigerant hose from the liquid port of the recovery cylinder. Close valve C.
21	**B, F**	Place the vacuum pump and connect a ⅜" vacuum hose. The vacuum pumps On-Off switch is in ON position. Plug and socket of the vacuum pump are not connected and placed behind the two (2) metre safety area. This will avoid sparking within the safety area with the operation of the "ON – OFF" switch.
22	**K**	Connect the vent-line to the exhaust port of the vacuum pump
23		There should not be a noteworthy overpressure remaining within the AC system except the out-gassing refrigerant from the compressors lubricant.
24		**Note that higher remaining refrigerant overpressure from the AC system will damage the vacuum pump during operation!**
25		Operate the vacuum pump by plugging in the power plug.
26	**A, B**	Open the low side valve A and the vacuum pump valve B at the manifold gauge set.
27		Operate the vacuum pump for about **20** minutes to remove most of the remaining R-290 refrigerant from the AC system.
28		End of the HC refrigerant recovery and venting process.
29	**A,B,C, D**	Valves at manifold gauge closed
30	**L, H**	Stop valves at the outdoor unit closed
31		Disconnect the vacuum pumps plug connector from power-socket (outside the 2 m safety area).
32		Remove the venting hose from the vacuum pump. Remove the manifold gauge set with hoses from the outdoor unit.
33		Place the recovery cylinder at the venting area where the flammable gas warning sign is placed and open the gas valve to vent any remaining HC gas from the cylinder. Drain the oil from the cylinder, (gas-valve) by holding the cylinder upside-down, in an appropriate container for used and contaminated lubricants.

Note:
The recovery cylinder for "oil-separation" should be used regularly for this purpose since the contamination with oil will not classify this cylinder for further activities with refrigerant, if not cleaned inside professionally.





The vacuum pump is used to recover the remaining HC refrigerant from the AC system.

For safety reasons the vacuum pump is switched ON and OFF by putting in the plug into the socket. Plug and socket are placed behind the two (2) metre safety area.

Equipment for the use of Oxygen Free and Dry Nitrogen (OFDN) in the field of RAC Servicing Practices

Nitrogen is a natural gas and does not contribute to environmental pollution in general if vented to the atmosphere. Nitrogen is tasteless, odourless and colourless and consists of 78.08 % within the air we breath. In addition, Nitrogen is non-flammable and does not support combustion. For refrigeration technologies Nitrogen is available in both, liquid and gaseous form. The nitrogen (OFDN) we commonly use for servicing refrigeration and air–conditioning systems is supplied and transported in high pressure cylinder.

Commonly RAC used OFDN cylinder are specified as follows:

Cylinder Content (Litre)	Filling Pressure (bar)	Gas Content (m^3)	Cylinder gross weight (ca. kg)
5	200	1	9.8
10	200	1,911	15.7
20	200	3,822	37.0
50	200	9,556	77.7
Purity 4.0 OFDN gas is of 99.99 % and a water content of maximum of 30 ppm.			

The nitrogen vented from a cylinder will reduce the oxygen content in the surrounding area and can cause suffocation!

Do not use oxygen or compressed air to pressurize RAC systems because when mixed with oil (e.g. compressor lubricant) for most refrigerants these gases can cause explosions!

For the use in RAC installation, servicing and maintenance technologies only use OFDN gas and cylinders in combination with a reliable and appropriate pressure regulator to safely reduce the pressure of the gas to a controlled level! The OFDN gas must only be transferred into the refrigerant circuit by the use of transfer hose designed and certificated for this purpose. For most cases refrigerant transfer hoses may have this classification. Check your refrigerant hoses for reliable use with pressurised OFDN gas.

OFDN gas in refrigeration is used in general for the following activities:

1. Leak test in combination with a weak soapy water solution (bubble test).
2. Pressure test (strength test) of RAC systems.
3. In mixed concentration with Hydrogen (95% Nitrogen and 5% Hydrogen) as a so-called Forming gas for Leak Test procedures in combination with Hydrogen Leak Detectors.
4. Refrigerant circuit flushing to remove contaminants and e.g. to free blocked components and capillaries from obstructions.
5. Purging of air from pipe work before heating and during brazing (to prevent formation of copper oxides on the inner surface of pipes).
6. Purging refrigerants from pipe work and components during brazing to avoid production of extremely toxic, acidic and harmful products.
7. To be used as “protective gas” and charged in a system or components for assembling to avoid introduction of air and humidity.
8. To clean surfaces of heat exchangers (e.g. condenser) from dust and dirt.

Only use OFDN gas and pressure cylinder in combination with a reliable and appropriate pressure regulator.

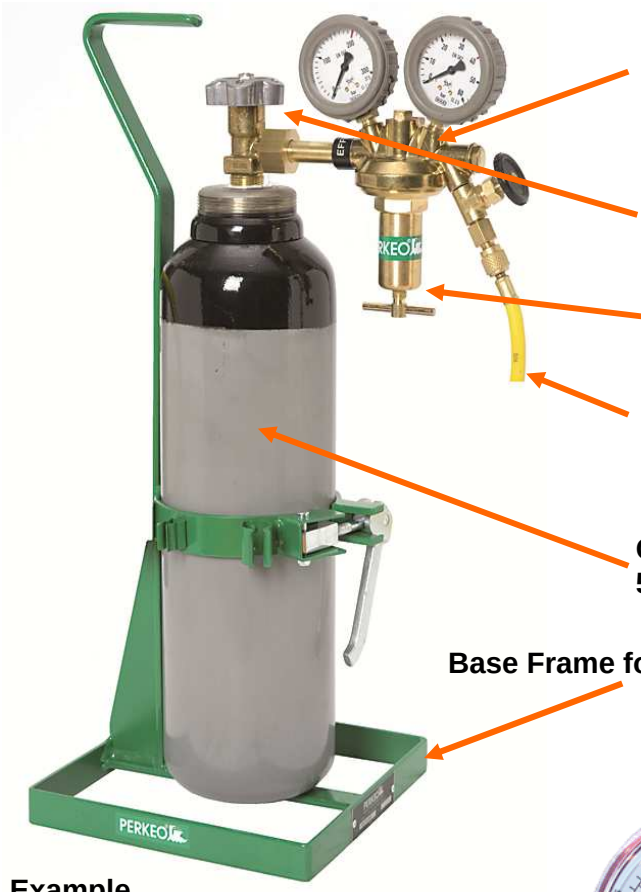
In most of the above-mentioned activities OFDN can deploy in addition its favourable capability to absorb a large part of remaining water content within a refrigerant circuit during system commissioning procedures.

Note:
Pressure regulators are designed to control the pressure and they are supplied with gauges to indicate pressure. Regulators do not measure or control flow of the OFDN media unless the arrangement is equipped with devices (metering valve or flow meter) specially designed for those purpose.

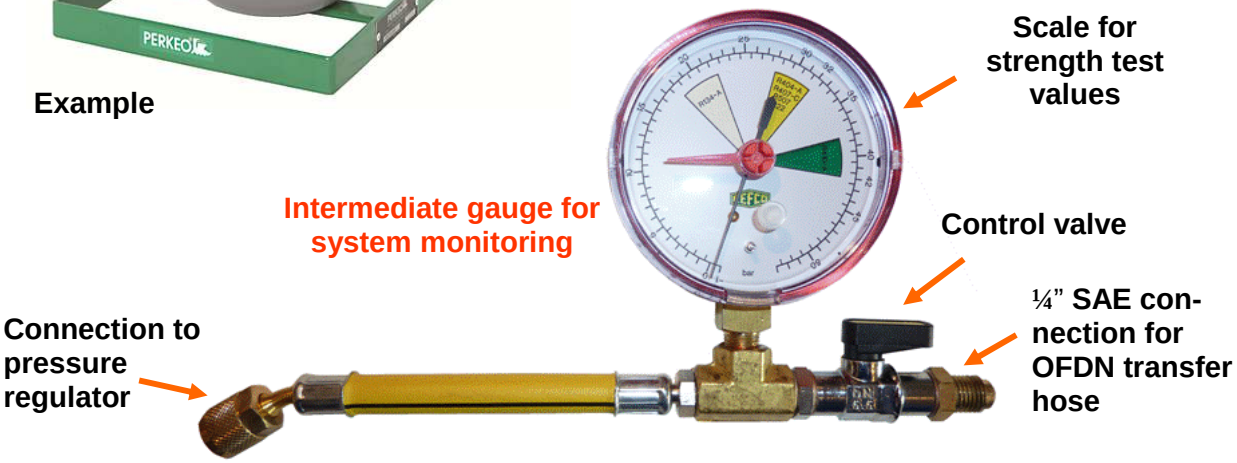
If possible use an intermediate pressure gauge, equipped with control valve, within the Nitrogen transfer hose for system monitoring (see next page)

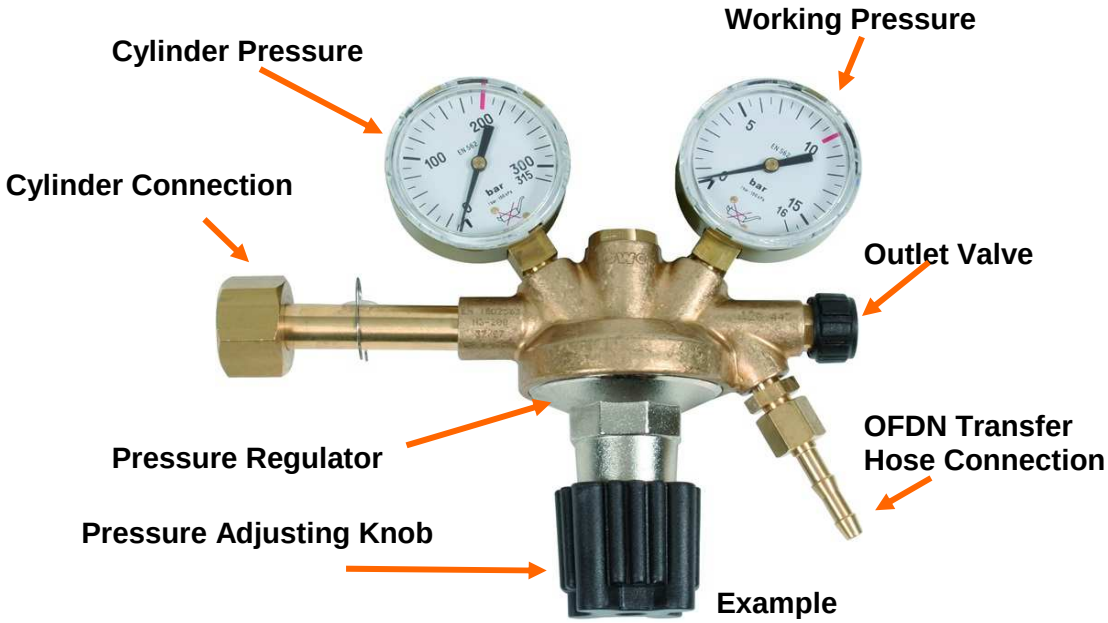
OFDN Cylinder and Pressure Regulator Arrangement

Only use OFDN gas and pressure cylinder in combination with a reliable and appropriate pressure regulator.



Example


Scale for strength test values
Intermediate gauge for system monitoring
Control valve
¼" SAE connection for OFDN transfer hose
Connection to pressure regulator



Example

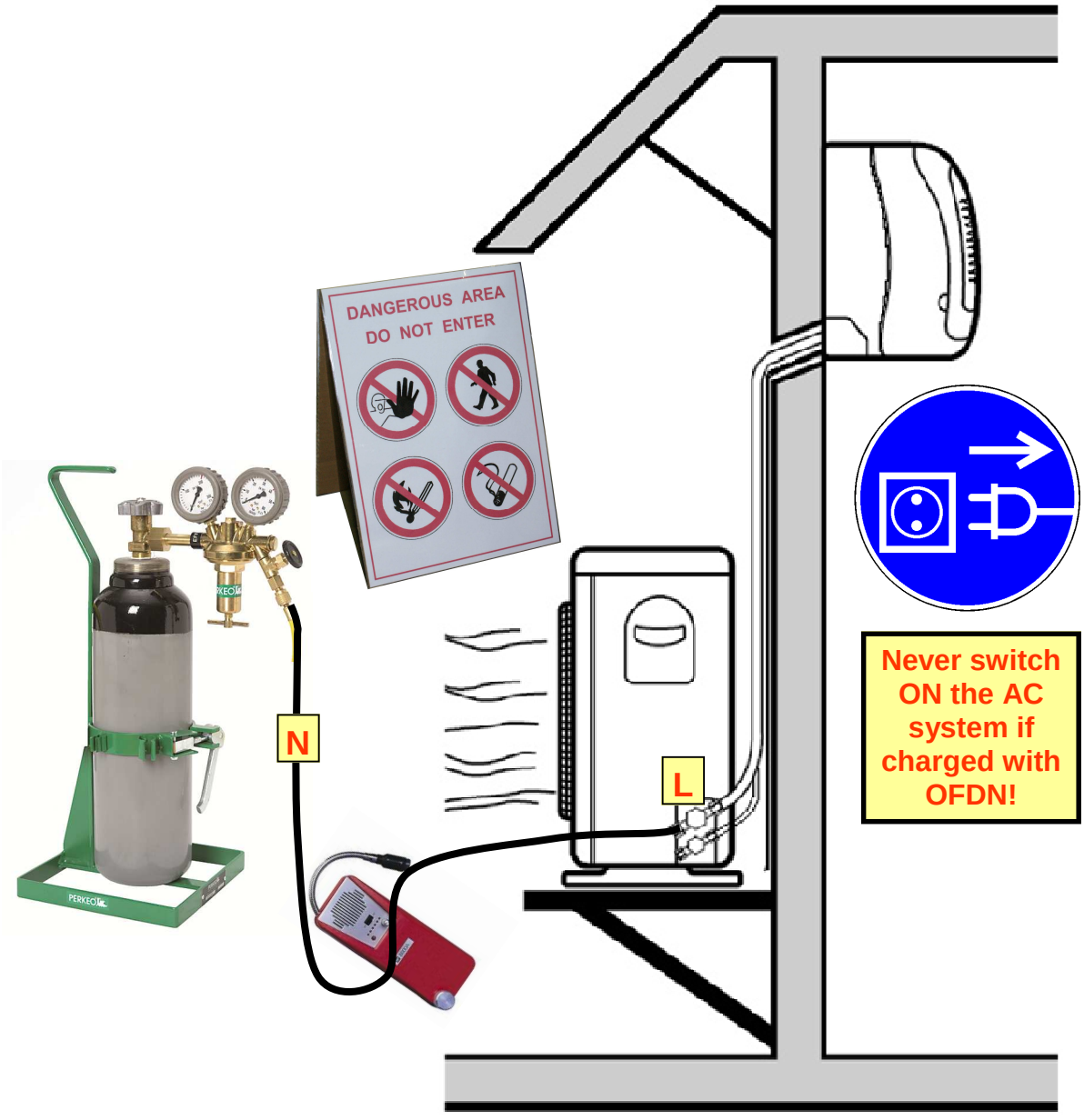
The use of “Oxygen Free and Dry Nitrogen” (OFDN)

Flushing the system and providing a “Holding Charge” of OFDN to the system:

After HC refrigerant removal (venting and recovery by vacuum pump) from the system, the empty refrigerant circuit should be flushed with OFDN in order to assure that there is no remaining HC in the system but also to blow-out other possible contaminants including humidity. In case of no further actions to the system e.g. disassembly of indoor and outdoor unit for transport to the companies repair shop or an on-site specific components replacement at a later date, an OFDN holding charge should be supplied to the refrigerant circuit. This is in general to avoid that air or humidity will be introduced into the system and cause contamination.

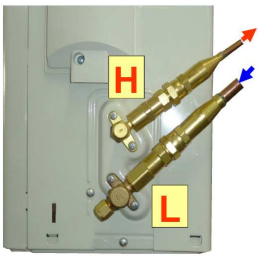
Provide a filled Nitrogen Cylinder (containing OFDN gas) equipped with reliable pressure regulator and Nitrogen transfer hose (N), having a ¼” SAE female adapter **and with Schrader valve core depressor**. Secure the cylinder!

The warning sign is still placed in the work-area because we are now handling a pressurised (about 250 bar) cylinder and OFDN gas is intentionally blown off from the system to the ambient area!



Flushing the system and provision of a “Holding Charge” with OFDN — Course of activities sequences

Section – Flushing with OFDN and provision of Holding Charge		
Steps recommended		
No	**Where**	**Activities**
1		Carry out all intended works without hurry and **THINK BEFORE ACTING!**
2		AC system “OFF” (unplugged) and emptied from HC refrigerant.
3		Arrange your tools and equipment connections as indicated on page 83. The pressure adjusting handle (screw) of the pressure regulator is back-seated. The cylinder valve and the pressure regulators outlet-valve to the OFDN transfer hose (N) is closed!
4	**N, L**	Assure that the nitrogen transfer hose with the connection at the suction line service port “L” consists of a core depressor to open the service port inner core valve during connection.
5	**N, L**	Connect the OFDN cylinder with transfer hose N to the service port of the outdoor units low-side stop valve L
6	**H, L**	Open the outdoor units low-side and high-side stop valves.
7		Open the OFDN cylinder valve
8		Adjust the pressure regulators pressure adjusting handle (screw) to about 10 bar shown at the delivery pressure gauge
9		Open slowly the pressure regulators outlet-valve
10		OFDN now is transferred into the complete AC system. Continue the transfer of Nitrogen until there is no further flow audible (pressure equalisation) and 10 bar is indicated.
11		Close the pressure regulators outlet-valve
12	**N, L**	Remove the OFDN transfer hose from the service port
13		Carefully open the service ports Schrader valve using a valve “pin” depressor (e.g. small screw-driver) and blow-out the Nitrogen charge. If necessary hold a piece of old cloth (or paper) into the flow stream to keep eventually escaping oil from the system. Ensure ventilation of the work space during gas venting. Do not inhale the escaping gas.
14		If there is no further flow of gas audible or sensible, the process of system flushing is finished.
15		To add an **OFDN Holding Charge** to the system start again with step **No. 5 to No. 12 and end with No. 16 and No. 17** of this course of activities. A charged amount of **about 5 bar** is sufficient.
16	**H, L**	Close the outdoor units low-side and high-side stop valves (front-seated position)
17		Close the OFDN cylinder valve. Return the pressure regulators adjusting handle (screw) in its back-seated position. Purge the pressure regulator from the outlet-valve (pressure regulator is now discharged).



Interconnection of the Manifold Gauge Set should only be considered for refrigerant handling or low-pressure OFDN use. High pressure OFDN use will cause early mechanical wear of the gauge set and manifolds supplied with sight glass can cause violation by accidentally pressing out the glass from the body!

To provide a “Holding Charge” to the system is in case of no further actions to the system for the time being.

Providing a Hermetically Sealed Refrigerant Circuit

Leak, Strength and Tightness Testing

General:
The sole purpose of this section is to raise awareness of the different methods to ensure a sealed system, applicable for GREE Air–Conditioners and to assist in determining the most appropriate one to use in different situations.

Best practice is to combine different leak finding methods to provide a hermetically sealed refrigerant circuit!

Combine 2 & 3 and if necessary + 5

Analysing a system to be free of leaks is the most important activity during RAC system installation, commissioning , maintenance or service. Having the proper test equipment is at least half of the job. Unfortunately there are so many methods of leak detection and so many types of test equipment, no one method fits every situation, especially if the refrigerant in use is flammable. Decisions need to be made as to the method used and the type of equipment needed for every leak to be found.

These conditions make leak testing one of the most challenging tasks faced by service technicians. In addition, national regulations are requiring service technicians to find leaks, thus not allowing technicians the choice of just adding refrigerant to keep the system in operation, which is indeed a dangerous practice for systems using flammable refrigerants.

Finally, the most important concern, handing over a safe and efficient system to the client, which has to be hermetically sealed and contains exactly the lowest amount of refrigerant charge required and is set up and configured to factory specifications and tolerances.

To provide a sealed refrigerant circuit the following direct refrigerant detection methods are recommended:

1. Leak Testing with the use of an electronic gas detector
2. Strength Testing by pressurising the system with OFDN
3. Tightness Testing by pressurising the system with OFDN and subsequent "Bubble Test"

   Alternative:
   Tightness Testing by pressurising the system with N2/H2 Forming Gas mixture and the use of a Trace Gas Leak Detector

Possible Leak finding methods applicable for GREE Air– Conditioners servicing:

	Direct Leak Finding Methods	To be used as;	**Not** recommended	**Must** have and do	Will be **excellent**
1	Soapy water bubble test with refrigerant pressure (only)	Leak Check	**X**		
2	Using an HC electronic Leak-Detector	Leak Test		**X**	
3	OFDN pressurised System and soapy water (Bubble Test)	Tightness Test		**X**	
4	N_2/H_2 Forming gas pressurised system and Trace Gas Detector	Tightness Test			**X**
5	Pressurising the System with OFDN	Pressure Test > refrigerant components are replaced		**X**	

In general, the **Gree Air–Conditioners are Factory Tested** for compliance with international standards and regulations. The factory test also includes a strength test. The HC R-290 Air-Conditioner is rated for a Maximum Allowable Pressure (PS) of 40 bar (4.0 MPa). For the new product installation and commissioning a sole Leak Test, using a reliable Electronic HC Leak Detector, has to be carried out.

If piping, components or areas are covered by oil, or you may hear the noise of escaping refrigerant (rough leaks), this may clearly indicate that there is a potential leak existing!

Regular Preventive Maintenance requires activities following Best Servicing Practices by employing indirect refrigerant detection techniques. Probably these activities may indicate requirements to carry out further direct detection procedures. Indirect checks for leakages include manual checks of the system and its operation conditions against the design operation conditions.

These activities will include analysis of the following parameters and conditions:

1. System Pressure
2. Temperatures
3. Compressor Current

Replace and tighten valve-caps, otherwise leakage is guaranteed!

Refrigerant Loss Indications shall be followed by comprehensive direct tightness testing method of the operational system by the use of the HC Leak Detector.

Refrigerant Loss Indicators are:

1. All deviations from normal operation conditions analysed from the above-mentioned indicators.
2. Any visible damage of the system.
3. Damage of pressure switch and sensors.
4. Corrosion and oil leaks.
5. Vibration, abnormal noise, ice formation.
6. Insufficient cooling capacity.

Having these preconditions of a sealed system in mind, in case of malfunction, after any modification or repair to the AC system (intervention into the refrigerant circuit) at least the affected part (refrigerant circuit piping or piping connections) shall be subject for a strength test (pressure test). The strength test pressure shall not exceed the strength test pressure applied to components by the manufacturer. During on-site activities, the complete AC system is subject for a pressure test.

The Pressure Test Value for the AC system (Strength Test) is at 1.1 times of the Maximum Allowable Pressure (PS), which is indicated at the outdoor units data plate.

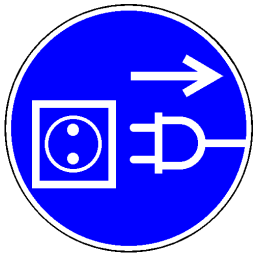
Pressure Test Value = 1.1 x PS (40 bar x 1.1) = 44 bar (4.4 MPa)

Procedures subsequent to the Pressure Test (Strength Test):

A Refrigerant Leakage Detection (Leak Test) must be carried out after Pressure Test.

Testing the system for leaks needs to pressurise the refrigerant circuit with the use of OFDN or if the equipment is available with a mixture of OFDN and Hydrogen (95% N_2 and 5% H_2) called “Forming Gas” in connection with an electronic N_2/H_2 Trace Gas Leak Detector.

Leak Check (Bubble Test) with a weak soapy water solution



Leak Testing with the use of “Weak Soap Solution with Water” only is not a reliable comprehensive Leak Testing activity but in combination with other leak testing methods it is a simple, sensitive technology. Specifically, the bubble test method would only be unsuitable if the system or section being tested is operating in a vacuum.

A soapy water solution can be used when you know the approximate area where a leak may exist and sufficient refrigerant pressure in the system is available. In addition it may be noticed that there is oil covering the surface of the suspected leak-spot. Previously e.g. an electronic leak detector has indicated a leak exists in a particular area of the hermetically sealed system. Mechanical connections will be the first choice to look for leaks in general.

Many different types of soap solutions are available on the market. Some technicians create their own soapy water solution. Some purchase bubble-test bottles and may have a pen-brush to apply the solution to the suspected point of leakage. A small brush is the best (cleanest) way to work with soapy water on RAC systems.

Some brands may provide “weak soap water solutions” in a spray bottle to cover quick “large” areas of pipe work or components for leak finding. Some soap solutions consist of an antifreeze mixture to avoid frosting of the solution on system parts. The advantage of most commercially produced solution for bubble test is that they have a lower density to make them even more sensitive to very tiny leaks.

Hints for the use of weak soap solutions:

1. If the system does not contain sufficient pressure for leak detection, the refrigerant can be recovered from the system and the system re-pressurised with OFDN to increase the pressure.
2. Probably in some cases the escaping Nitrogen is audible and indicates the leakage location.
3. Do not pressurise the system or component to be checked, more than the manufactures leak testing standards. This pressure is usually stated on the data plate as “Maximum Allowable Pressure”.
4. In most cases for the purpose of leak testing, a safe pressure is usually about 10 bar (150 psig).

Example of “Bubble Test” application and a commercially provided Leak Check fluid with Pin Brush

Electronic Gas Detectors

Using an electronic gas detector is generally the fastest way to find an unknown leak or at least if refrigerant is present in the surrounding area. They can be used to quickly find a leak, or to find the area in which the leak exists in a system when you don't even know where to start.

The electronic gas detector is good for most leaks if the device is used and maintained correctly.

Note: For the use with Hydrocarbon refrigerants (here HC R-290) it is important to make sure that the detector is safe and sensitive for this refrigerant. Regularly used electronic gas detectors for CFC, HCFC or HFC refrigerants are in most cases not designed for the use with HC R-290, so check with your equipment provider and review the product manual if the gas detector is safe for your specific use.

An electronic gas detector gets you very close to the leak spot and can indicate leaks of less than 5 grams per year. After you find the area in which the leak is detected, you can usually decrease the sensitivity of your detector to indicate the area of the leak. Cover the leak area with some weak soap water solution to verify the exact point of the leak.

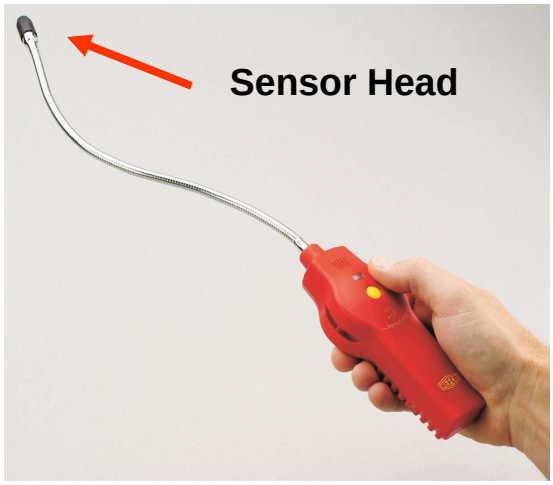
The use of Gas Detectors designed for HC Refrigerant is a SAFETY issue!

Regular Gas Detectors may not be safe for the use with HCs!

Hints for the use of electronic leak detectors:

1. Check your device at least once a year to ensure reliability and accuracy. Your equipment supplier can guide you on how to carry out calibration. In most cases it is possible to use a "reference leak source" for calibration.
2. Know your gas detector's capabilities and also what it is not capable of detecting.
3. Carbon monoxide and alcohol can affect the sensitivity of most electronic gas detectors. Be sure neither is present when checking for leaks.
4. For optimum leak detection, hold the sensor head as close as possible over the refrigerant transferring pipe. Move the sensor head slowly along the pipe with a maximum of 1 cm per second of speed.
5. Mechanical connections (screwed unions) or other connections must be "scanned" slowly, move the sensor head right around the complete connection point.
6. When the Gas Detector indicates a leak, it is advisable to hold the sensor head away from the leakage site (spot) identified, for approximately 5 seconds. Then check whether the device indicates a leak at the same spot again. Repeat this procedure step-by-step three times. This will verify if a leak really leak exists.
7. During other work activities with HCs (installation, service, maintenance) place the Gas Detector on the floor of your work area and the device can act as a HC Gas Warner!

The HC gas detector is part of a Personal Protection Equipment (PPE)



Example of a Gas Detector, designed and safe for the use with HC refrigerants

HC refrigerant has a higher specific volume than air, therefore the refrigerants will fall when exposed to atmospheric pressure.

This means leak detecting on the bottom sides of the piping or components can be effective.

Leak Testing with OFDN and weak soapy water solution

Never switch ON the AC system if charged with OFDN!

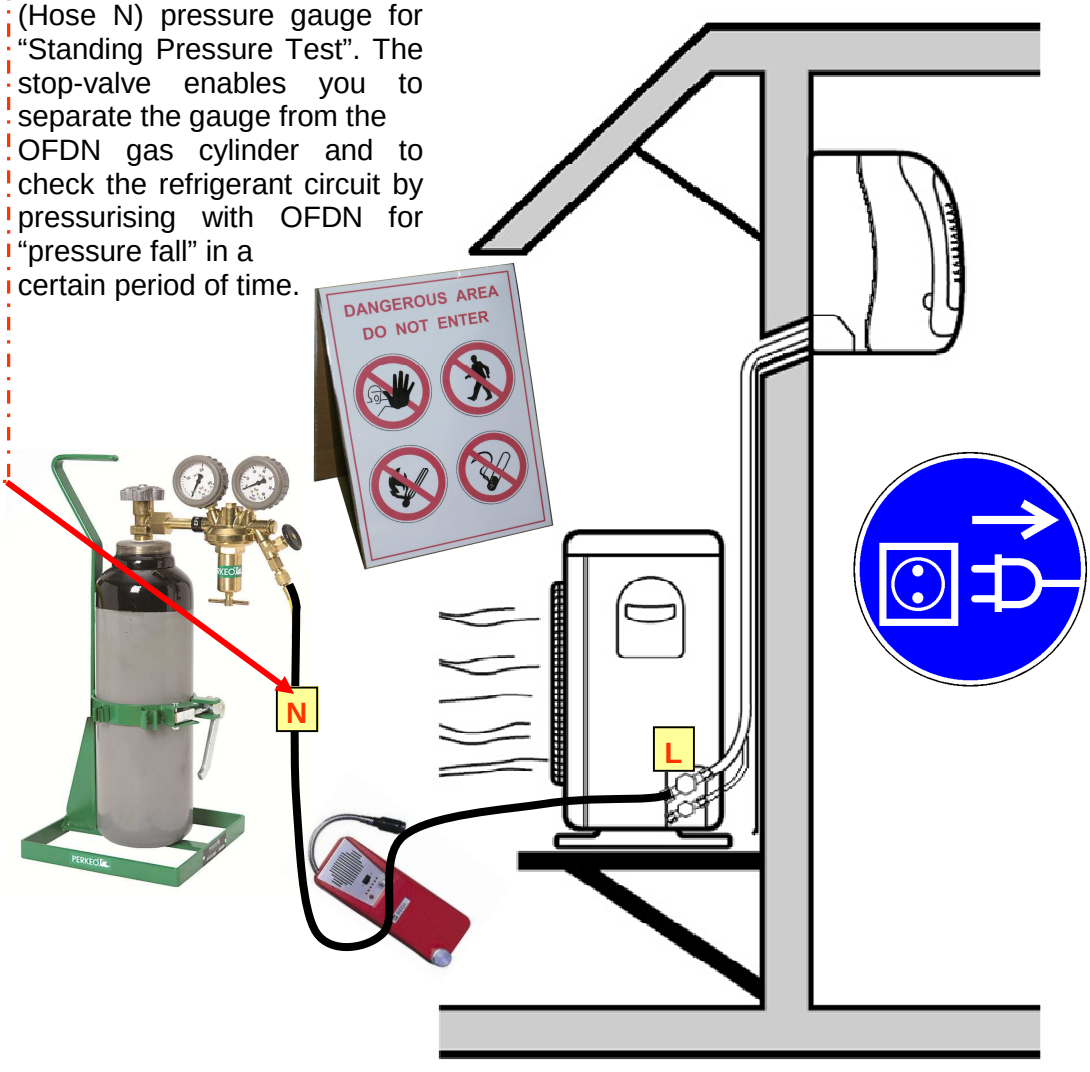
This method consists of pressurising the empty refrigerant circuit with a reasonably high pressure of OFDN gas. A pressure, usually up to 10 bar (150 PSI) is applicable. The subsequently carried out Leak Test using a weak soapy water solution shall cover all potential areas of possible leakages.

Provide a filled Nitrogen cylinder (containing OFDN gas) equipped with reliable pressure regulator and Nitrogen transfer hose (N), having a ¼" SAE female adapter **and with Schrader valve core depressor**.

The warning sign is still placed in the work-area because we are now handling a pressurised cylinder (about 250 bar) and OFDN gas is intentionally blown off from the system to the ambient area.

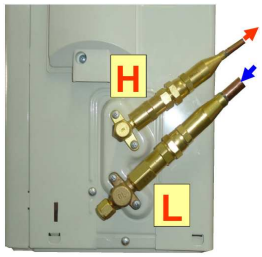
It is advisable to have an intermediate pressure gauge, equipped with control valve, within the Nitrogen transfer hose (N) to be separated from the pressure regulator and the OFDN gas cylinder. This arrangement will enable you to carry out a "Standing Pressure Test" and after a period of time to identify whether or not the pressure drops during this time within the AC system (or specific separated parts of the system). Fortunately, the dry Nitrogen charge in the AC system experiences a very little pressure change when the AC system is exposed to small temperature changes with the environment. This procedure may enable you to verify that the system, or separated parts of it, is free of leaks.

Example of an intermediate (Hose N) pressure gauge for "Standing Pressure Test". The stop-valve enables you to separate the gauge from the OFDN gas cylinder and to check the refrigerant circuit by pressurising with OFDN for "pressure fall" in a certain period of time.



Leak Testing with OFDN gas and “Weak Soapy Water Solution”
Course of activities sequences

Section – Leak Test with OFDN and Bubble Test		
Steps recommended		
No	**Where**	**Activities**
1		Carry out all intended works without hurry and **THINK BEFORE ACTING!**
2		AC system “OFF“ (unplugged) and emptied from HC refrigerant.
3		Arrange your tools and equipment connections as indicated on page 89. The pressure adjusting handle (screw) of the pressure regulator is back-seated. The cylinder valve and the pressure regulators outlet-valve to the OFDN transfer hose (N) is closed!
4	**N, L**	Ensure that the Nitrogen transfer hose with the connection at the suction line service port “L” consists of a core depressor to open the service port inner core valve during connection.
5	**N, L**	Connect the OFDN cylinder with transfer hose N to the service port of the outdoor units low-side stop valve L
6	**H, L**	Open the outdoor units low-side and high-side stop valves.
7		Open the OFDN cylinder valve
8		Adjust the pressure regulators pressure adjusting handle (screw) to about 10 bar (150 PSI) shown at the delivery pressure gauge
9		Open slowly the pressure regulators outlet-valve
10		OFDN is now transferred into the complete AC system. Continue the transfer of Nitrogen until there is no further flow audible (pressure equalisation) and 10 bar (150 PSI) is indicated. Watch the gauge for pressure loss!
11		Close the pressure regulators outlet-valve
12		Carry out the Leak Test by covering potential brazed joints, mechanical unions or piping, with the weak soapy water solution and carefully search for bubbles. Additionally, the amount of discharging Nitrogen will indicate a leak with creating a venting noise. Repeat the Bubble Test until you are confident that no leaks exist. Use a small mirror for places that are difficult for assessment.
13	**N, L**	Remove the OFDN transfer hose from the service port
14		Carefully open the service ports Schrader valve using a valve “pin” depressor (e.g. a small screw-driver) and blow-out the Nitrogen charge. If necessary hold a piece of old cloth (or paper) into the flow stream to keep eventually escaping oil from the system. Do not inhale the escaping gas. Ensure ventilation of the work space during gas venting. Leave a slight overpressure in the system.
15		**If a leak was found in step 12, repair the leak or replace the leaky component and continue with steps 5 and 7 to 14.**
16	**H, L**	Close the outdoor units low-side and high-side stop valves (front-seated position)
17		Close the OFDN cylinder valve. Return the pressure regulators adjusting handle (screw) in its back-seated position. Purge the pressure regulator from the outlet-valve (pressure regulator is now discharged).



Interconnection of the Manifold Gauge Set should only be considered for refrigerant handling or low-pressure OFDN use. High pressure OFDN use will cause early mechanical wear of the gauge set and manifolds supplied with sight glass can cause violation by accidentally pressing out the glass from the body!

N_2/H_2 Leak Testing (Trace Gas Leak Detection)

A leak detection with the use of trace gas is a very reliable method and can find even very small leaks with a leakage rate less than 1 gram per year. This technology enables service technicians to leak-test a system at lower pressure.

A process recognised as a “Fine Leak Test” is based on the use of the Forming gas as the test gas in conjunction with a special leak detector. Forming gas is a mixture of Nitrogen (N_2) and Hydrogen (H_2). A suitable electronic gas detector must be used — a standard gas detector is not sensitive to Hydrogen. The favourable physical properties of hydrogen are made use of here for detecting leaks. Forming gas in proportion of 95/5 % for RAC purpose contains 95% Nitrogen and 5% Hydrogen. Hydrogen constituents can escape from even the smallest leaks, and will be detected by the gas detector. A test pressure of about 5 bar is adequate for reliable fine leak test.

The use of Leak Detectors designed for Trace Gas Leak Detection is a very accurate testing method!

Regular Gas Detectors are not useful for this technology.

The climate neutral Hydrogen gas is the smallest natural occurring molecule. The favourable physical property of H_2 gas means that it diffuses through insulating materials (or other covering material) if a leak occurs. This makes it possible to test refrigerant transfer pipes or components (including mechanical connections) covered with insulating material without removing or damaging it. The gas can penetrate even screed, foam etc. Hydrogen Leak Detectors do not have a cross-sensitivity and for that reason a false alarm is not possible from external gases. Since Hydrogen gas has a smaller density than air (14 times lighter) it always rises and makes “tracing” above pipes possible.

The Hydrogen share in the Forming gas serves as Trace gas, and only this gas is selected by the electronic sensor from the leak detector.

This leak test technology can be applied generally to all RAC systems and heat pumps. Hydrogen (H_2) is a naturally occurring gas and is charged with the Nitrogen into the empty refrigerant circuit. After leak testing the gas can be vented safely into the environment.

Never switch ON the AC system if charged with OFDN and Trace gas!

Hints for the use of Hydrogen Trace Gas (H_2) leak detectors:

1. Check your device at least once a year to ensure reliability and accuracy.
2. For optimum leak detection, hold the sensor head as close as possible over the refrigerant transferring pipe. Move the sensor head slowly along the pipe with a maximum speed of **0.2 cm** per second.
3. Mechanical connections (screwed unions) or other connections must be “scanned” slowly, move the sensor head right around the complete connection point.
4. When the Leak Detector indicates a leak, it is advisable to hold the sensor head away from the leakage site (spot) identified, for approximately 5 to 10 seconds. Then check whether the device indicates a leak at the same spot again. Repeat this step up to three times. This will verify if a leak really exists!

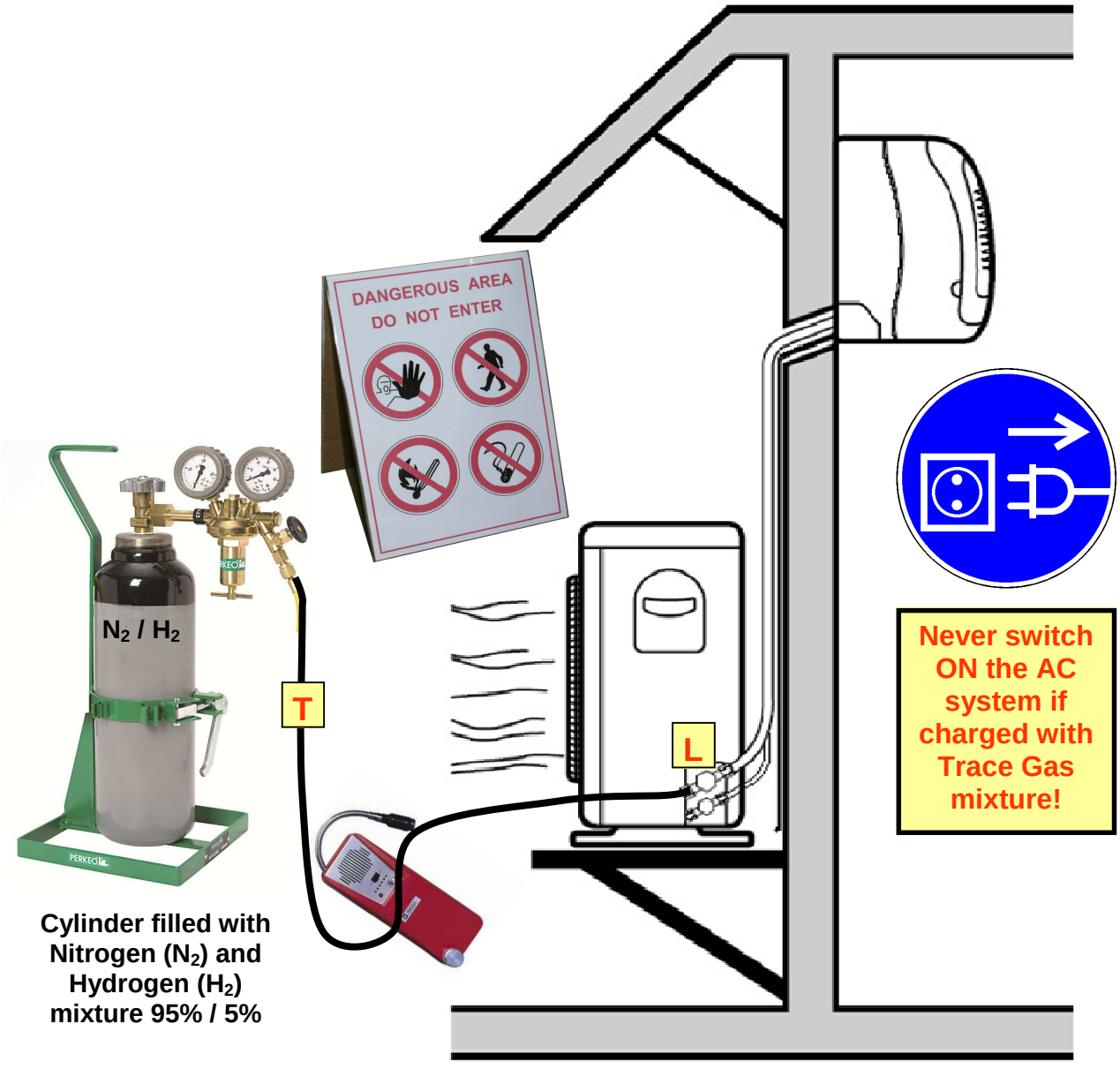
Example of Leak Detector for Hydrogen Trace Gas

Leak Testing with N_2/H_2 Trace Gas

This method consists of pressurising the empty refrigerant circuit with the Forming Gas mixture N_2/H_2 Trace gas. A pressure, usually about 5 bar (72.5 PSI) is applicable. The subsequently carried out Leak Test using a Hydrogen (H_2) Trace Gas Leak Detector shall cover all potential areas of possible leakages.

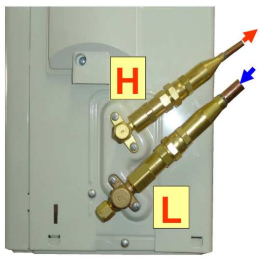
Provide a filled Forming Gas Cylinder (containing the H_2/N_2 mixture gas) equipped with reliable pressure regulator and transfer hose (T), having a ¼" SAE female adapter **and with Schrader valve core depressor**.

The warning sign is still placed in the work-area because we are now handling a pressurised (about 250 bar) gas cylinder with a gas mixture and after works the gas is intentionally blown off from the system to the ambient area!



Cylinder filled with Nitrogen (N_2) and Hydrogen (H_2) mixture 95% / 5%

N_2/H_2 Trace Gas Leak Detection — Course of activities sequences



Section – Trace Gas Leak Detection		
Steps recommended		
No	**Where**	**Activities**
1		Carry out all intended works without hurry and **THINK BEFORE ACTING!**
2		AC system “OFF“ (unplugged) and emptied from HC refrigerant.
3		Arrange your tools and equipment connections as indicated on page 92. The pressure adjusting handle (screw) of the pressure regulator is back-seated. The cylinder valve and the pressure regulators outlet-valve to the trace gas transfer hose (T) is closed!
4	**T, L**	Ensure that the trace gas transfer hose with the connection at the suction line service port “L” consists of a core depressor to open the service port inner core valve during connection.
5	**T, L**	Connect the trace gas cylinder with transfer hose T to the service port of the outdoor units low-side stop valve L
6	**H, L**	Open the outdoor units low-side and high-side stop valves.
7		Open the trace gas cylinder valve
8		Adjust the pressure regulators pressure adjusting handle (screw) to about 5 bar (72.5 PSI) shown at the delivery pressure gauge
9		Open slowly the pressure regulators outlet-valve
10		Trace gas is now transferred into the complete AC system. Continue the transfer of gas until there is no further flow audible (pressure equalisation) and 5 bar (72.5 PSI) is indicated. Watch the gauge for pressure loss!
11		Close the pressure regulators outlet-valve
12		Carry out the Leak Test and hold the sensor head of the trace gas leak detector as close as possible over the heat exchangers, refrigerant transferring pipes and mechanical connections. Move the sensor head slowly along the components with a maximum of **0.2 cm** per second of speed. Repeat the screening test until you are confident that no leaks exist.
13	**T, L**	Remove the trace gas transfer hose from the service port
14		Carefully open the service ports Schrader valve using a valve “pin” depressor (e.g. small screw-driver) and blow-out trace gas charge. If necessary hold a piece of old cloth (or paper) into the flow stream to keep eventually escaping oil from the system. Do not inhale the escaping gas. Leave a slight overpressure in the system. Ensure ventilation of the work space during gas venting.
15		**If a leak was found in step 12, repair the leak or replace the leaky component and continue with step 5 and 7 to 14.**
16	**H, L**	Close the outdoor units low-side and high-side stop valves (front-seated position)
17		Close the trace gas cylinder valve. Return the pressure regulators adjusting handle (screw) in its back-seated position. Purge the pressure regulator from the outlet-valve (pressure regulator is now discharged).

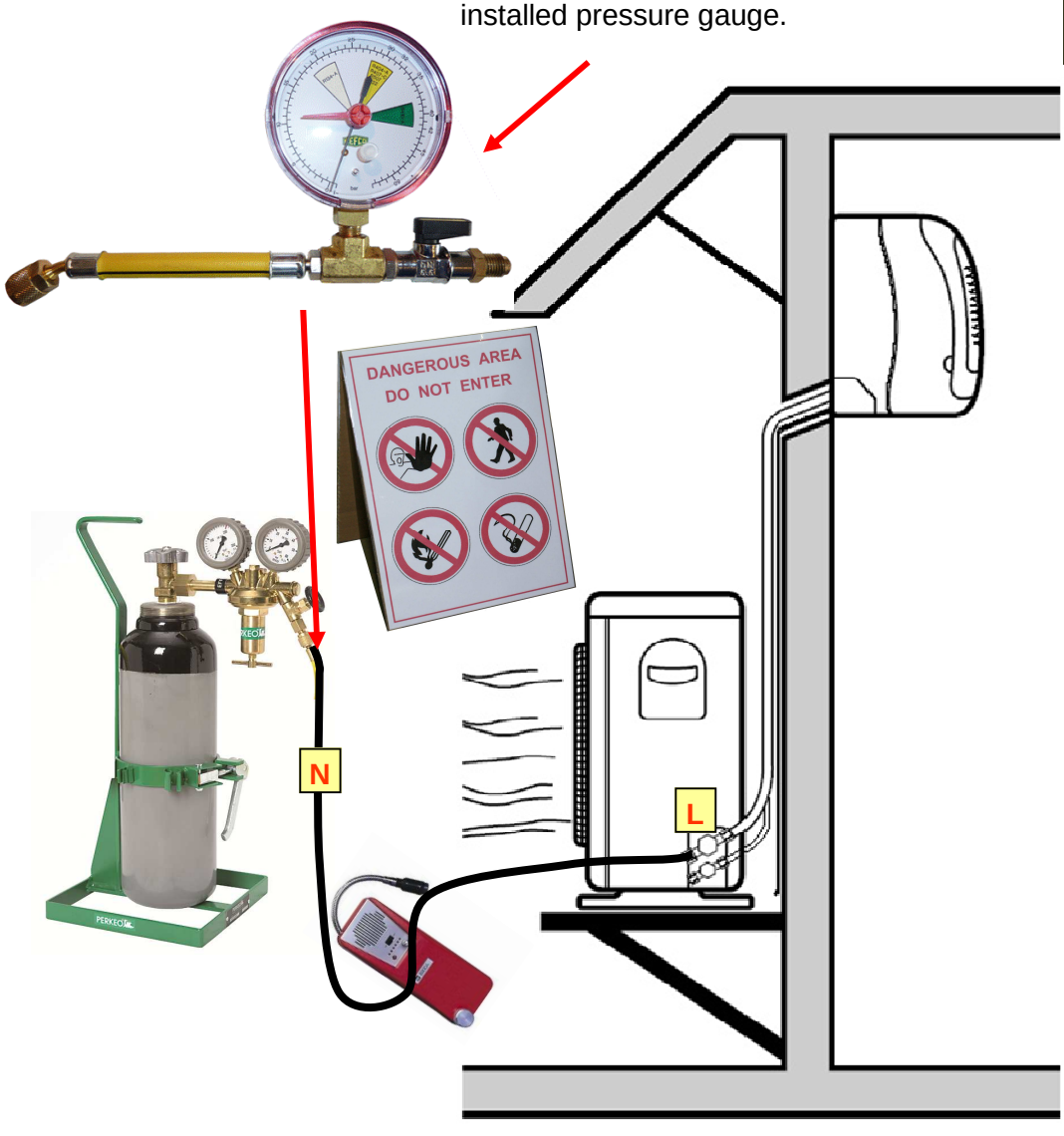
Pressure Test (Strength test) with OFDN

After any modification or repair to the AC system “intervention into the refrigerant circuit”, at least the affected part (refrigerant circuit piping or piping connections) shall be subjected to a strength test (pressure test). The strength test pressure shall not exceed the strength test pressure applied to components by the manufacturer; this may require the testing of the low-pressure side of the system separately from the high-pressure side. In fact, this is not possible for the installed GREE AC units and, in specific for heat-pumps (not applicable here), is not necessary. The pressure in the system shall be built up gradually and monitored by remote gauge or other indicator located in a safe place. Use the Nitrogen cylinders outlet pressure gauge (or an intermediate pressure gauge between pressure regulator and AC outdoor unit) for pressure monitoring.

Do not use the manifold gauge set for strength test pressure monitoring. This is a dangerous practice and may cause violation.

Ensure that the pressure regulator at the Nitrogen cylinder is suitable for the use with RAC systems (maximum output 50 bar)! Ensure that no unauthorised persons are within vulnerable locations in case of an inadvertent pressure burst.

Example of an intermediate (Hose N) installed pressure gauge.



Interconnection of the Manifold Gauge Set should only be considered for refrigerant handling or low-pressure OFDN use. High pressure OFDN use will cause early mechanical wear of the gauge set and manifolds supplied with sight glass can cause violation by accidentally pressing out the glass from the body!

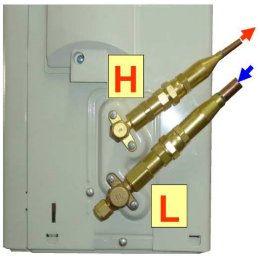
Never switch ON the AC system if charged with OFDN!

The Pressure Test Value for the AC system (Strength Test) is at 1.1 times the Maximum Allowable Pressure (PS), which is indicated at the outdoor units data plate.

Pressure Test Value = 1.1 x PS (40 bar) = 44 bar (4.4 MPa)

Pressure Test (Strength Test) with OFDN — Course of activities sequences

Section – Pressure Test (Strength Test) with OFDN		
Steps recommended		
No	**Where**	**Activities**
1		Carry out all intended works without hurry and **THINK BEFORE ACTING!**
2		AC system “OFF“ (unplugged) and emptied from HC refrigerant.
3		Arrange your tools and equipment connections as indicated on page 94. The pressure adjusting handle (screw) of the pressure regulator is back-seated. The cylinder valve and the pressure regulators outlet-valve to the OFDN transfer hose (N) is closed!
4	**N, L**	Ensure that the Nitrogen transfer hose with the connection at the suction line service port “L” consists of a core depressor to open the service port inner core valve during connection.
5	**N, L**	Connect the OFDN cylinder with transfer hose N to the service port of the outdoor units low-side stop valve L.
6	**H, L**	Open the outdoor units low-side and high-side stop valves.
7		Open the OFDN cylinder valve.
8		Adjust the pressure regulators pressure adjusting handle (screw) to about 10 bar (150 PSI) shown at the delivery pressure gauge
9		Open slowly the pressure regulators outlet-valve.
10		OFDN is now transferred into the complete AC system. Continue the transfer of Nitrogen until there is no further flow audible (pressure equalisation) and 10 bar (150 PSI) is indicated. Watch the gauge for pressure loss!
11		Slowly turn the pressure regulators adjusting handle to increase the system pressure in stages of about 3 bar (45 PSI) at a time and listen for any audible pressure loss at every step of adjustment. Watch the gauge!
12		When the pressure test value of 44 bar (4.4 MPa) is reached, close the pressure regulators outlet-valve and the cylinder valve. Listen for any audible pressure loss and watch and note the pressure at the gauge. Wind the pressure regulators pressure adjusting handle in back-seated position (pressure regulator is now discharged).
13		Carry out a Leak Test by covering potential brazed joints, mechanical unions or piping, with the weak soapy water solution and carefully search for bubbles. Additionally, the amount of discharging Nitrogen will indicate a leak by creating a venting noise. Repeat the Bubble Test until you are confident that no leaks exist. Use a small mirror for places that are difficult for assessment.
14	**N, L**	Remove the OFDN transfer hose from the service port.
15		Carefully open the service ports Schrader valve using a valve “pin” depressor (e.g. a small screw-driver) and blow-out the Nitrogen charge. If necessary hold a piece of old cloth (or paper) into the flow stream to keep eventually escaping oil from the system. Do not inhale the escaping gas. Ensure ventilation of the work space during gas venting. Leave a slight overpressure in the system.
16		**If a leak was found in step 12, repair the leak or replace the leaky component and continue with steps 5 and 7 to 14.**
17	**H, L**	Close the outdoor units low-side and high-side stop valves (front-seated position)



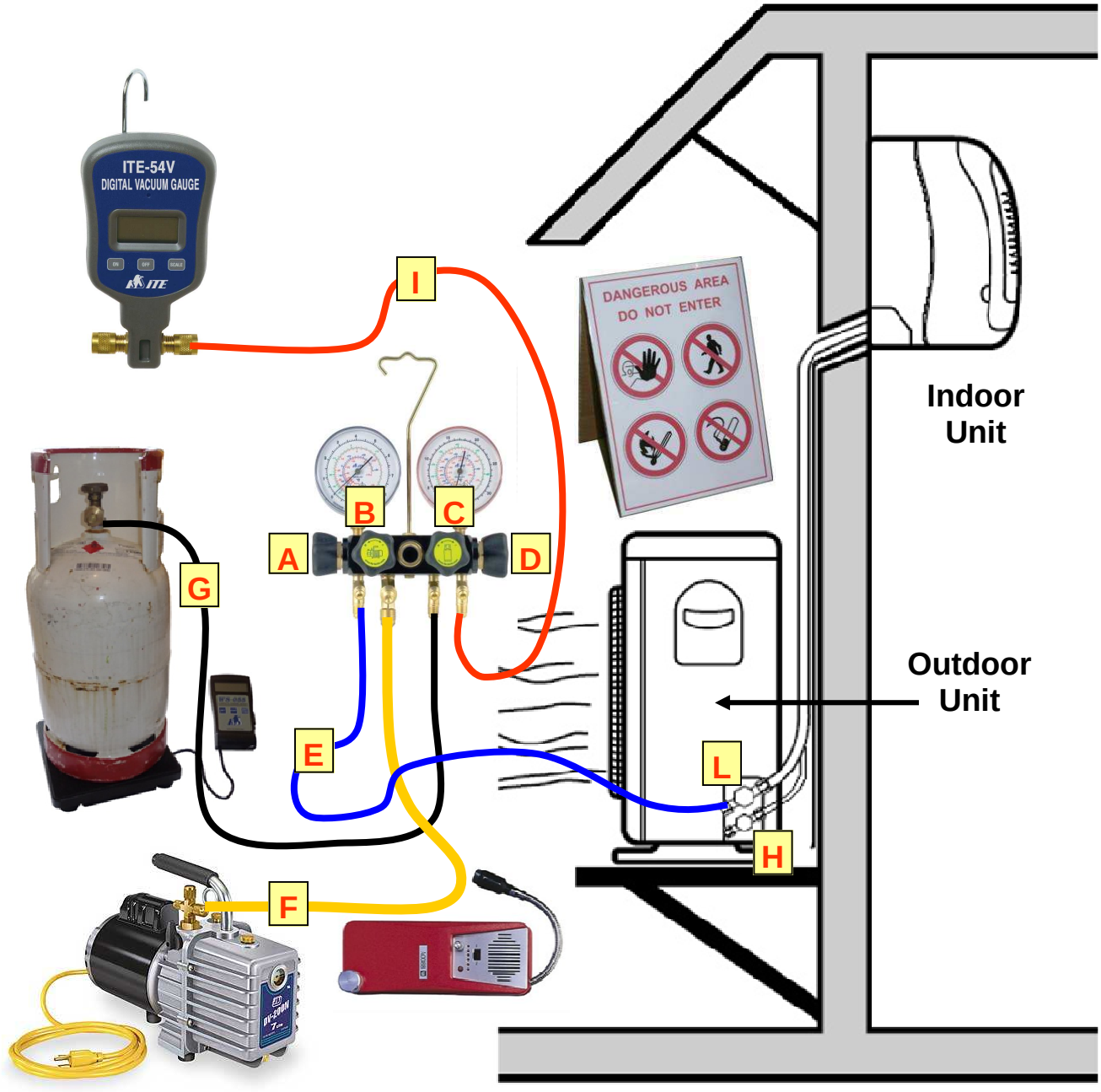
The Pressure Test Value for the AC system (Strength Test) is at 1.1 times of the Maximum Allowable Pressure (PS) which is indicated at the outdoor units data plate.

Pressure Test Value = 1.1 x PS (40 bar) = 44 bar (4.4 MPa)

Ensure that no unauthorised persons are within vulnerable locations in case of an inadvertent pressure burst.

Refrigerant Circuit—Evacuation and Charging

	Valve		Refrigerant Hose
A	Manifold >Low Pressure Gauge	E	Connection Hose valve A > L, Outdoor Unit
B	Manifold > Vacuum Pump	F	Connection Hose valve B > Vacuum Pump
C	Manifold > Refrigerant Cylinder	G	Connection Hose valve C > R-290 Cylinder
D	Manifold (Vacuum Gauge)	I	Connection Hose valve D > Vacuum Gauge
H	Outdoor Unit Liquid Side (High)		
L	Outdoor Unit Gas Side (Low)		



Refrigerant Circuit Evacuation

Do not use the AC-Systems refrigerant compressor or a compressor in general for vacuum processing!

A reliable dual-stage vacuum pump is required!

Measure the vacuum required with an appropriate calibrated vacuum gauge!

The Gree HC Air-Conditioner, as previously explained, is an intrinsic safe system, which comes factory pre-assembled and already charged with R-290 refrigerant ready for installation and commissioning at the client's site. The content of impurities, non-condensable gases (e.g. air, nitrogen, etc.) and humidity within the refrigerant circuit is better than the industrial standard and this means that the inner environment of the system is absolutely clean! For first field installation of the new air–conditioning system the use of a vacuum pump is not necessary.

For After-Sales servicing procedures the diagram on the previous page indicates the arrangement of equipment and tools and the interconnection with refrigerant hoses for drawing a vacuum at the system and finally charging with refrigerant. These are activities in general where flammable refrigerant can be present. Please refer to page 75 and respect the temporary flammable zones for your intended work activities and arrange for the safety area of 2 metres within your work space (see page 74). **Keep in mind that before evacuation and charging of the system, the filter-drier has to be changed.**

The process of drawing a vacuum (evacuation)

Before charging a refrigerant circuit of any RAC system with refrigerant, a good vacuum should be drawn. This is in general to remove non-condensable gases, such as air, nitrogen or forming-gas and to dehydrate the system. Under no circumstances shall the system compressor or another refrigerant compressor be used as a vacuum pump. The reason for this is, on the one hand a refrigerant compressor cannot achieve the vacuum required and on the other hand, the AC systems compressor can be damaged by operation in a vacuum.

Favourable equipment specifications for system evacuation are as follows:

1. Always use a dual stage vacuum pump equipped with gas ballast valve and appropriate to the volume of the refrigerant circuit (about 170 litres/minute or 6 CFM) and the capability for an ultimate vacuum of 15 micron (0.020 mbar).
2. The vacuum pump should have ⅜" and ¼" male flare connections
3. At best, the vacuum pump should have a solenoid valve at the suction port to avoid any draw-back of air into the system due to a power cut during operation.
4. The vacuum pump should have an oil-mist filter at the outlet with connection for the Hydrocarbon vent hose.
5. The vacuum pump should be regularly checked for sufficient and clean vacuum pump lubricant.
6. For system evacuation, the vacuum pump should be connected and operated at the low– and high-side of the system. The operation of a vacuum pump at the GREE HC Air-conditioner, the connection to the low-side only is possible (service port provision).
7. In order to achieve the best efficiency of the pump, according to the pumps capabilities, the vacuum hose should be of the largest diameter (⅜" diameter and 2 x ⅜" female flare SAE connection) and kept to a minimum length (about 1 metre).
8. The vacuum hose should not have core depressors (pressure drop to high within the hose during evacuation)
9. The manifold gauge set should have a valve port for the vacuum pump with ⅜" and ¼" SAE male flare connection.
10. A suitable calibrated vacuum gauge (best possible an electronic device) shall be connected to a point on the system furthest from the vacuum pump. For the GREE HC Air-conditioner service, the connection at the manifold gauge set is indicated.

Monitor the evacuation procedure to maintain at least a required vacuum value of 375 Micron (0.5 mbar or 50 Pa) or higher. The time used for maintaining this value is related to the contamination of the system. In case you cannot achieve this required vacuum level the following analysis should take place:

1. Check the system connected tools and hose connections for any leakages.
2. Check the complete system for leakages.
3. Otherwise there is a high content of water in the system.

For situation No. 3 an additional flushing of the system with OFDN can support the evacuation procedure and decrease the time spent to maintain the desired vacuum level.

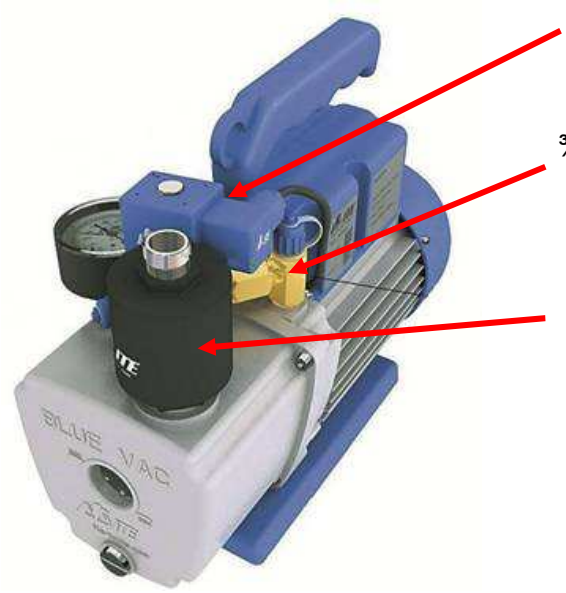
To ensure that there is no leak left in the system the desired vacuum level should be held without any significant rise during a 30 minutes time span whilst isolated (valve “C” closed at the manifold gauge set) and, with switched off vacuum pump.

For the intention to carry out a multiple evacuation process (to increase the dryness level within the system), do not break the vacuum with refrigerant! Only use OFDN for this purpose.

NOTE:
The required vacuum value is of about 375 Micron (0.5 mbar, 50 Pa) or higher!

Measure the vacuum level with a reliable vacuum gauge

To break the vacuum (multiple evacuation process) only use OFDN gas!

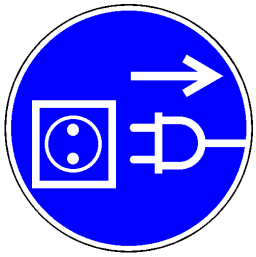


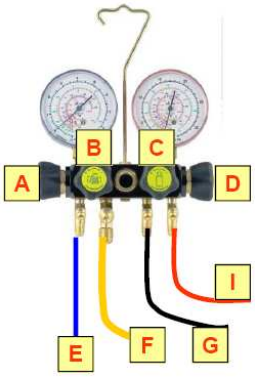
Example Vacuum Pump

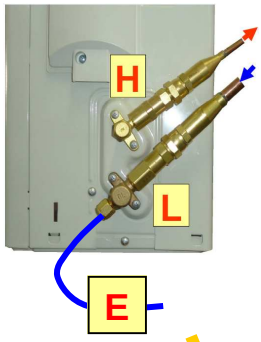
Example Vacuum Hose
⅜” with SAE connections

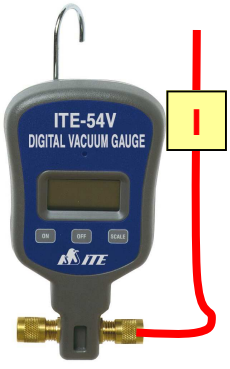
Electronic Vacuum Gauge
for Micron, Hg, mbar, Pa
indication

Section - Refrigerant Circuit Evacuation		
Steps recommended		
No	**Where**	**Activities**
1		Carry out all intended works without hurry and **THINK BEFORE ACTING!**
2		AC system “OFF” (unplugged) and emptied from HC refrigerant, OFDN or forming-gas. If necessary purge any left overpressure from the system.
3		Arrange your tools and equipment connections as indicated on page 96. Ensure that the refrigerant hose “E” with the connection at the suction line service port “L” consists of a core depressor to open the service port inner core valve during connection. The warning sign is still placed in the work-area.
4	**A, B, C, D**	Manifold gauge valves are closed.
5	**L & H**	Open the stop valves at the condensing units high– and low- side.
6	**A**	Open the manifold low-pressure valve.
7		Operate the vacuum pump by plugging in the power plug.
8		Note that placing the vacuum pump at work site should be in “ON” mode but not connected to the electrical socket! The electrical socket is outside the 2 m safety area. This will avoid sparking within the safety area with the operation of the “ON – OFF” switch.
10	**B, C, D**	Open manifold gauge valves (vacuum pump, refrigerant cylinder, vacuum gauge).
11		The refrigerant cylinder valve is left closed but the charging hose “G” will be evacuated during this process.
12		Obtain a vacuum of 375 Micron (0.5 mbar or 50 Pa) as indicated by the vacuum gauge.
13	**B**	Closed manifold gauge valve (vacuum pump).
14		Switch off vacuum pump remote from plug.
15		Observe vacuum gauge if pressure rises for about 30 minutes.
16		If the pressure rises but does not reach the atmospheric pressure (Zero), it indicates humidity in the system. Open B and prolong evacuation process.
17		If the pressure rises to 0 bar gauge (1 bar absolute or 100 kPa), this will indicate that there is a leak in the refrigerant circuit, the split-unit connections or the manifold gauge and hose assembly. Check system or connections for leaks.
18		The vacuum pressure stays stable.
19	**A, C, D**	Closed manifold gauge valves (low-pressure, refrigerant charging, vacuum gauge).
20		Refrigerant circuit is evacuated and ready for charging with refrigerant.









Charging with HC R-290 refrigerant

Remember that the GREE HC Air–conditioner is an intrinsic safe system where modifications of the refrigerant circuit are not acceptable. This applies specifically to the length of refrigerant pipes and the amount of charged refrigerant. The specified refrigerant charge of the AC Split-Unit is exactly 0.2 kg (200 grams) of HC R-290. The specified amount of refrigerant for the air–conditioners design-conditions is indicated on the data-plate and rated in kilograms.

In case of lack of refrigerant!

The operation of the GREE Air–conditioner is only permitted with the use of refrigerant R-290 for this specific technology.
Extreme care should be taken not to overfill the system. Topping up of the system with refrigerant is not permitted. This will infringe the safety certification of the air–conditioner. If a loss of refrigerant is indicated you are advised to carry out the following activities;

1. Always follow the advices stated within this manual, to provide a safe working area. Refer to pages 74 and 75 of this manual.
2. Vent the remaining amount of refrigerant as indicated on pages 76 to 80 of this manual.
3. Flush the system with OFDN, see pages 83 and 84.
4. Carry out a leak test (leak finding) with OFDN and a soapy water solution, see pages 89 and 90.
5. Repair the leak or replace the defective component by using only OEM spare-parts.
6. Carry out a pressure test with subsequent leak test, see pages 94 and 95.
7. Evacuate and dehydrate the system, see pages 96 to 99.
8. Recharge the system with the specified amount of 0.2 kg of HC R-290 refrigerant, following the given guideline within this chapter.
9. A follow up leak test using an appropriate HC leak detector should always be carried out prior to leaving the site.

NEVER Top-Up the system with refrigerant, always follow the guidelines provided with this chapter!

Do not backward retrofit the GREE Air-Conditioner to any other refrigerant. This will result in the operation of the system away from the design conditions, causing a loss of system efficiency.
The operation of the system with any other type of refrigerant can cause system failure and probably violation of property and health.

The process of charging

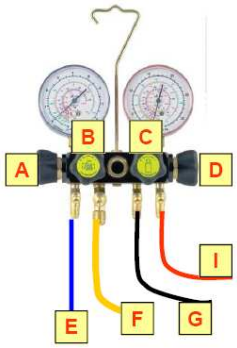
The charging of RAC systems with HC refrigerants is similar to those using halocarbon (e.g. HCFC R-22) refrigerants. Since Hydrocarbon R-290 (Propane) is a pure refrigerant the charging can take place in gaseous or liquid state. Keeping in mind that the specified refrigerant charge amount of the GREE Air–conditioner is relatively low and service port of the AC unit is provided at the low -pressure side only, the charging of this system can be done by taking only vapour from the refrigerant cylinder and charging to the suction line of the compressor by measuring the weight of refrigerant. The charging amount should be monitored by the use of accurate and sensitive scales. For safety reasons and to provide accurate charging, the smallest refrigerant cylinder sizes possible should be used.

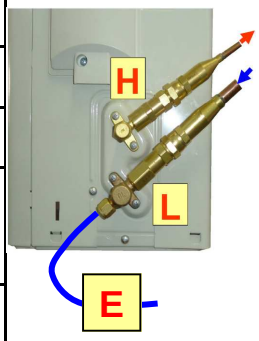
Arrange your equipment and tools as indicated on pages 100 and 101.

Example of a sensitive charging scale:

Capacity = 100 kg
Accuracy = +/- 0.5 %
Resolution = 2 gram

Section - Charging with HC refrigerant R-290		
Steps recommended		
No	**Where**	**Activities**
1		Carry out all intended works without hurry and **THINK BEFORE ACTING!**
2		Continuing from section - Evacuation
3		Arrange your tools and equipment connections as indicated on page 96. Ensure that the refrigerant transfer hose “E” with the connection at the suction line service port “L” consists of a core depressor to open the service port inner core valve during connection. The warning sign is placed in the work-area.
4		AC system “OFF”, evacuated and dehydrated.
5	**A, B, C, D**	Manifold gauge valves are closed.
6	**L & H**	Stop valves at condensing unit are open
7		Open the refrigerant cylinder valve
8		Zero the weighing scales
9	**A**	Open the low pressure valve at the manifold gauge.
10	**C**	Open the refrigerant valve at the manifold gauge. Transfer refrigerant vapour slowly (50% of total charge) into the suction side of the condensing unit
11		Measure (note) transferred (charged) refrigerant amount
12	**C**	Close the refrigerant charging valve of the manifold gauge set.
13		Switch on the unit to **COOLING MODE,** bearing in mind that there is a time delay of 3 minutes until the compressor starts.
14	**C**	Open the refrigerant charging valve “C” of the manifold gauge set and slowly charge accurately the remaining refrigerant amount.
15		Close the refrigerant cylinder valve
16		Record the system data (use provided form from page 102).
17	**H**	Close stop valve at condensing unit (HP). Stem in front-seated position to pump down and transfer the refrigerant into the high side section of the AC unit.
18		If low pressure gauge indicates 0 bar, all refrigerant remaining in the hoses assembly and gauges manifold set is sucked back into the AC unit.
19	**A**	Closed
20	**H**	Open the high pressure stop valve at the outdoor unit. Stem in back-seated position.
21	**B, C, D**	Closed
22		Remove Manifold and install end-caps.
23	**L & H**	Final leak check with soapy water or electronic HC leak detector. H – while operational AC unit L – in “off“ mode
24		General functional test of the system and system labelling.
25		Fill Start-Up data sheet for “Service and Repair” works





Start Up Data Sheet for GREE Split Air-Conditioner—Service and Repair	
Installation Company	
Address	
Telephone & Fax	
Technician Name	
Registration No.	
Client / Company	
Contact Person	

Installation / Appliance DATA	
Model and No.	
Date of Installation / Repair	
Comments / Repair	

Operating Data – Cooling Mode		
Refrigerant Type	R-290	
Refrigerant Name	Propane	
Refrigerant charge in kg	0.20	
Suction Pressure P1		
Suction Temp. P1		
Air Temp. entering condenser T3		
Air Temp. leaving condenser T4		
Air Temp. entering evaporator T1		**Flammable Refrigerant**
Air Temp. leaving evaporator T2		

Performance Test: **With appliance commissioning please operate the Split- Air conditioner with HIGH indoor fan speed in mode COOLING for a minimum of 15 Minutes. Measure air inlet (T1) and air outlet (T2) temperature at the indoor unit. The temperature difference should be at least 8 K.**

Electrical Data	
Power Supply (Voltage)	
Overall Ampere Reading	
Current draw Compressor	

Other executions for system commissioning!	**Tick box for completion**
Only use correct and reliable tools / equipment for system commissioning!	
Functional AC system check including performance test!	
Check the Ac system for refrigerant leakage!	
Check that electrical connections are tight!	
Check that condensate drain is tight and with down-grade!	
Check insulation of refrigerant transfer tubes and quick-coupler!	
Check free run of condenser and evaporator fans!	
Check system operation (indoor/outdoor) on abnormal operational noise!	
Clean system components including air filter (if indicated)	
Check display of the remote controller!	
Execute briefing of the AC system user!	

Company signature and date:	Client signature and date:

Service Label to be place at the outdoor unit after service and repair.

Flammable Refrigerant R-290 Service	
Company	
Engineer Name	
Address	
Telephone & Fax No.	
Registration No.	
Flammable Refrigerant	**This System is charged with the natural and environmentally protective Refrigerant R-290**
Refrigerant Charge in kg	**0,20**
Lubricant Type & Charge	
Date:	
Signature:	

If you leave the system, ensure that all valves are capped and tight (O-ring and gaskets); uncapped valves are a very common source of leakage!

Dismantling, Recycling and Disposal

At the end of the life cycle of the GREE HC R-290 Air–conditioner (discontinuation of operation, economically irreparable damage) the following general activities and precautions should be implemented:

1. Avoid any hazards to operatives carrying out dismantling processes.
2. Plug-in appliance is electrically disconnected or arrangements made for appropriately licensed person to isolate hard-wired appliances.
3. Refrigerant is adequately vented, recovered, stored and disposed of in accordance with the national legislative and industry requirements and standards.
4. Units and components are removed and disposed of safely and in accordance with regulations, industry codes of practice and sustainable environmental practices.
5. The worksite is cleaned and left in presentable condition, client and organisational requirements, industry standards and sustainable environmental practices.
6. Decommissioning and disposal documentation is completed and processed in accordance with national State regulatory requirements.

For decommissioning of the AC system and recycling or disposal of components and substances always follow the national legal requirements and environmental protection standards.

When a refrigeration or air-conditioning system is to be decommissioned, taken out of use and dismantled, or sold intact, the user who no longer requires the system, or the use thereof, shall ensure that:

either,

- the decommissioned system is leak tight so that there is very little risk of leakage during storage, and
- the new user of the system, or the dismantler/disposer of the system is made aware in writing of the type and quantity of refrigerant and oil contained within it, and is fully conversant with the legal and other requirements for its safe storage, handling and ultimate disposal;

or,

- the system refrigerant (and oil) charge has been adequately vented (small charge amount of Hydrocarbon refrigerant R-290) or recovered and evacuated, using a recovery unit as required, and is disposed of properly prior to decommissioning, sale or dismantling.

Only trained and certified personnel must carry out activities to maintain decommissioning of the AC system and disposal or recycling of components and substances.

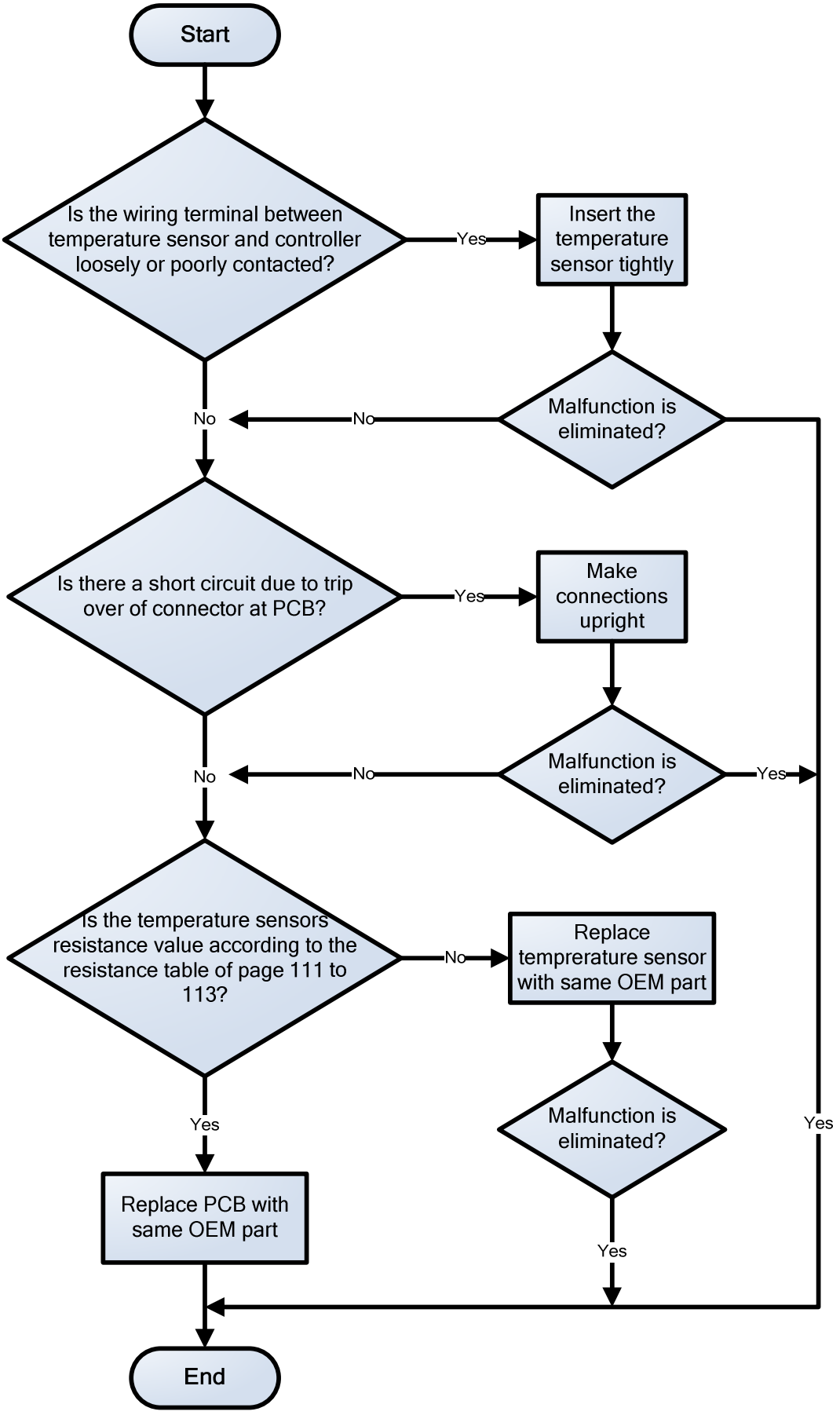
Error Codes, LED Flashing and Trouble Shooting

Ensure that the power input is under normal as specified with the technical details of the unit. According to the error code, identify the possible malfunction of the unit.

No.	Malfunction Name	Error Code	A/C Status	Possible Causes
1	Indoor ambient temperature sensor is open/ short-circuited	F1	The unit will stop operation as it reaches the temperature point. During cooling and drying operation, except when indoor fan operates, other loads （such as compressor, outdoor fan, 4-way valve） stop operation; During heating operation, the complete unit stops operation.	1. The wiring terminal between indoor ambient temperature sensor and controller is loosened or poorly contacted; 2. There's short circuit due to trip-over of the parts on controller; 3.Indoor ambient temperature sensor is damaged (Please check it by referring to the resistance table for temperature sensor) 4. Main board is broken.
2	Indoor evaporator temperature sensor is open/ short-circuited	F2	The unit will stop operation as it reaches the temperature point. During cooling and drying operation, except when indoor fan operates, other loads stop operation; During heating operation, the complete unit stops operation.	1. The wiring terminal between indoor evaporator temperature sensor and controller is loosened or poorly contacted; 2. There's short circuit due to the trip-over of the parts on controller; 3.Indoor evaporator temperature sensor is damaged (Please check it by referring to the resistance table for temperature sensor) 4. Main board is broken.
3	Outdoor ambient temperature sensor is open/ short-circuited	F3	The unit will stop operation as it reaches the temperature point. During cooling and drying operation, compressor stops and indoor fan operates; During heating operation, the complete unit stops operation.	1. The wiring terminal between outdoor ambient temperature sensor and controller is loosened or poorly contacted; 2. There's short circuit due to the trip-over of the parts on controller; 3.Outdoor ambient temperature sensor is damaged (Please check it by referring to the resistance table for temperature sensor) 4. Main board is broken.
4	PG motor (indoor fan motor) does not operate	H6	Indoor fan, outdoor fan, compressor and electric heat tube stop operation. 2 minutes later, 4-way valve stops; horizontal louver stops at the current position.	1.The feedback terminal of PG motor is not connected tightly. 2.The control terminal of PG motor is not connected tightly. 3.Fan blade rotates roughly due to improper installation. 4.Motor is not installed properly and tightly. 5.Motor is damaged. 6.Controller is damaged.
5	Malfunction protection of jumper cap	C5	Operation of remote controller or control panel is available, but the unit won't act.	There's no jumper cap on the controller. Jumper cap is not inserted properly and tightly. Jumper cap is damaged. Controller is damaged.
6	PG motor (indoor fan) circuit malfunction by zero cross detection	U8	Operation of remote controller or control panel is available, but the unit won't act.	1. Controller is damaged.
7	Freeze protection	E2	During cooling and drying operation, compressor and outdoor fan stop while indoor fan operates.	1. Poor air-return in indoor unit; 2. Abnormal fan speed; 3. Dirty evaporator; 4. System is normal but the indoor tube temperature sensor is abnormal, or the tube temperature sensor is not connected well.
8	Low pressure protection of compressor	E3	The complete unit stops	1. The main board and display panel are not connected well. 2. The LPP terminal on the main board is not connected well, with the high pressure switch on the complete unit. 3. The wiring of the high pressure switch is loosened. High pressure switch is damaged or poorly contacted. 4. Insufficient or leaking out refrigerant. 5. The LPP input is at high level.

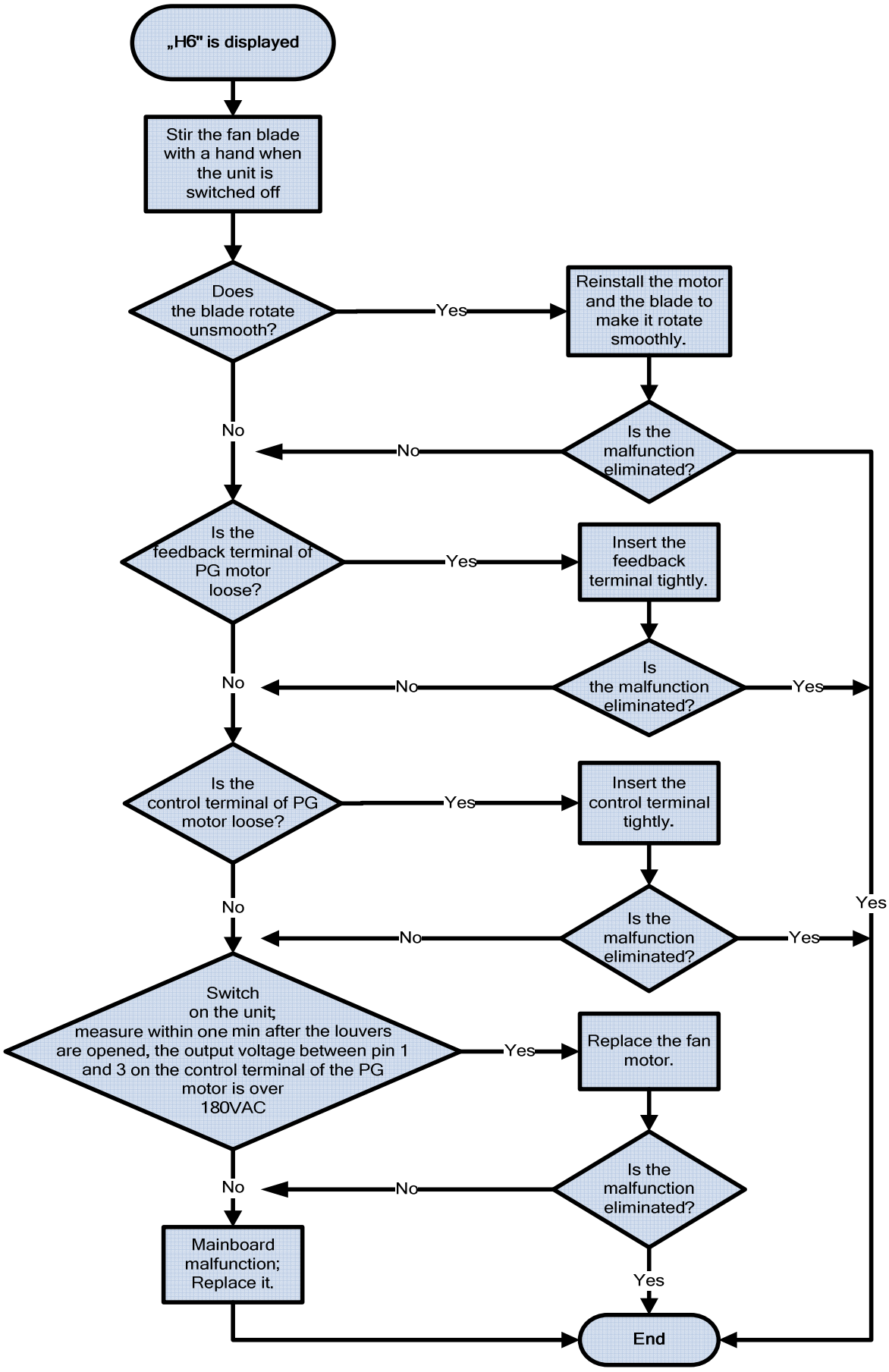
Trouble Shooting for the Temperature Sensor

According to the below-provided diagram, identify the possible malfunction related to the temperature sensor.



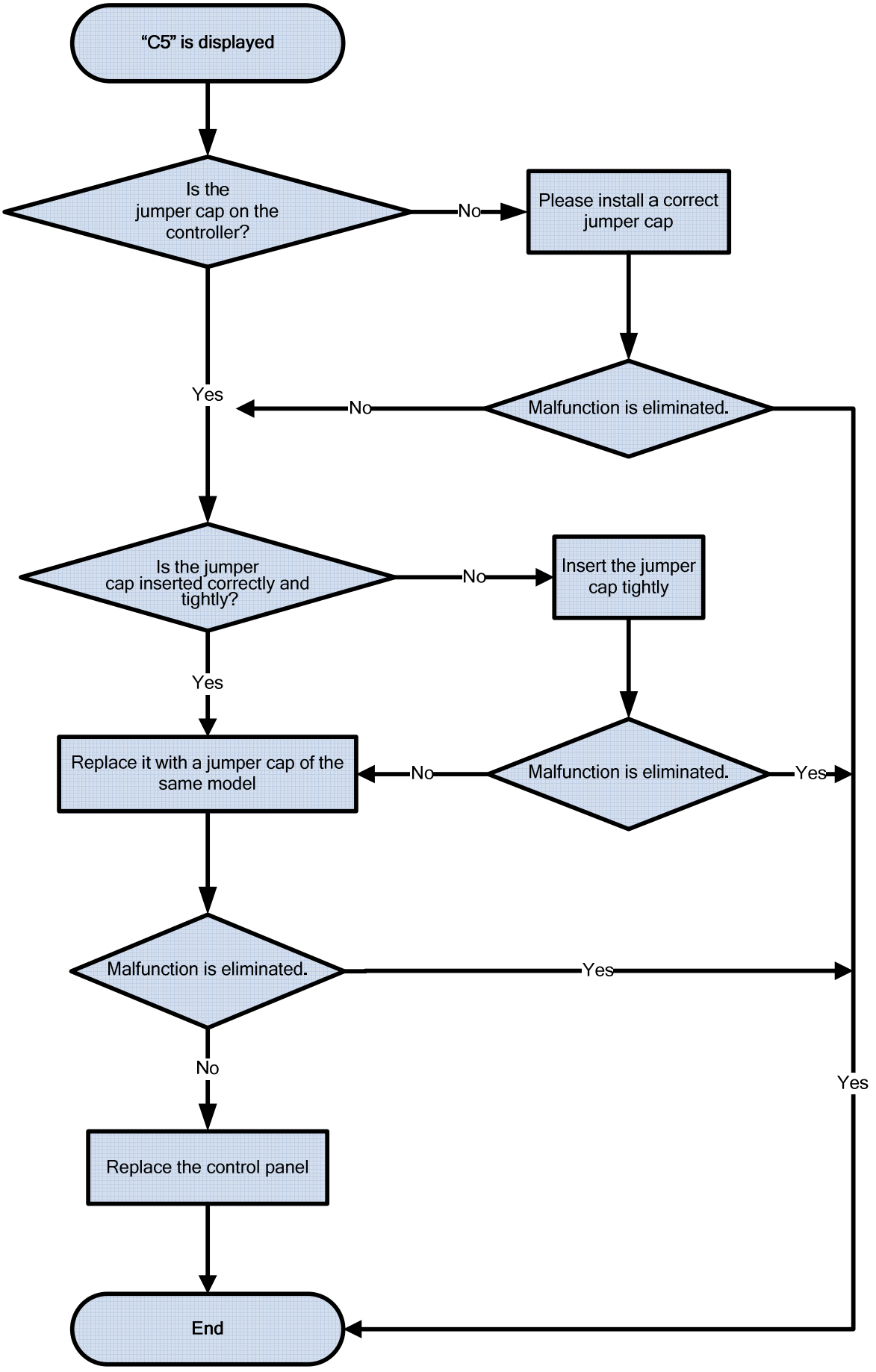
Trouble Shooting for the PG motor

According to the below-provided diagram, identify the possible malfunction related to the indoor fan (PG motor) and “H6” error code indication.


„H6" is displayed
Stir the fan blade with a hand when the unit is switched off
Does the blade rotate unsmooth?
Yes
Reinstall the motor and the blade to make it rotate smoothly.
No
Is the malfunction eliminated?
No
Is the feedback terminal of PG motor loose?
Yes
Insert the feedback terminal tightly.
No
Is the malfunction eliminated?
No
Yes
Is the control terminal of PG motor loose?
Yes
Insert the control terminal tightly.
No
Is the malfunction eliminated?
No
Yes
Yes
Switch on the unit; measure within one min after the louvers are opened, the output voltage between pin 1 and 3 on the control terminal of the PG motor is over 180VAC
Yes
Replace the fan motor.
No
Is the malfunction eliminated?
No
Yes
Mainboard malfunction; Replace it.
End

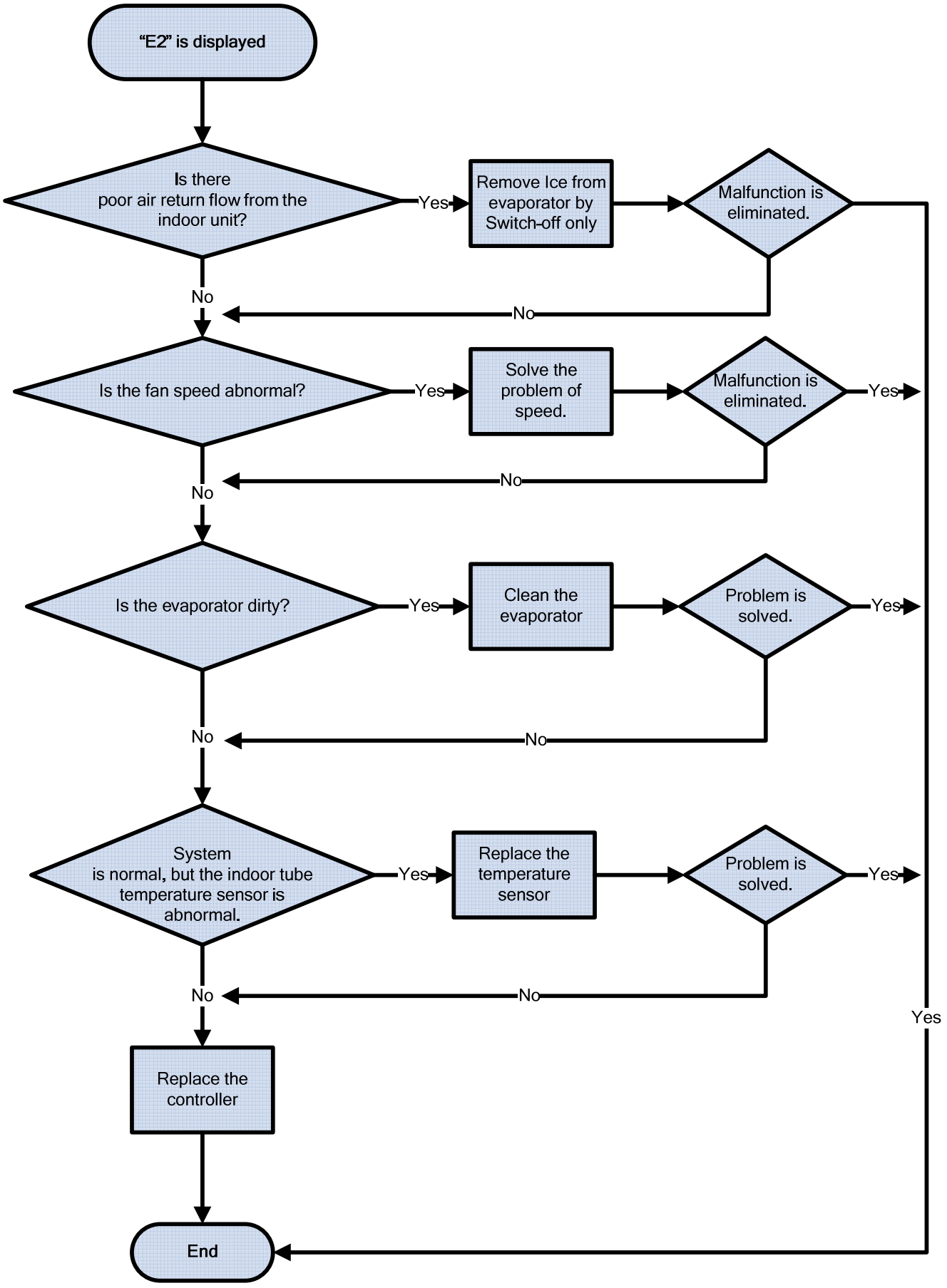
Trouble Shooting for Jumper Cap Malfunction

According to the below-provided diagram, identify the possible malfunction related to the Jumper Cap



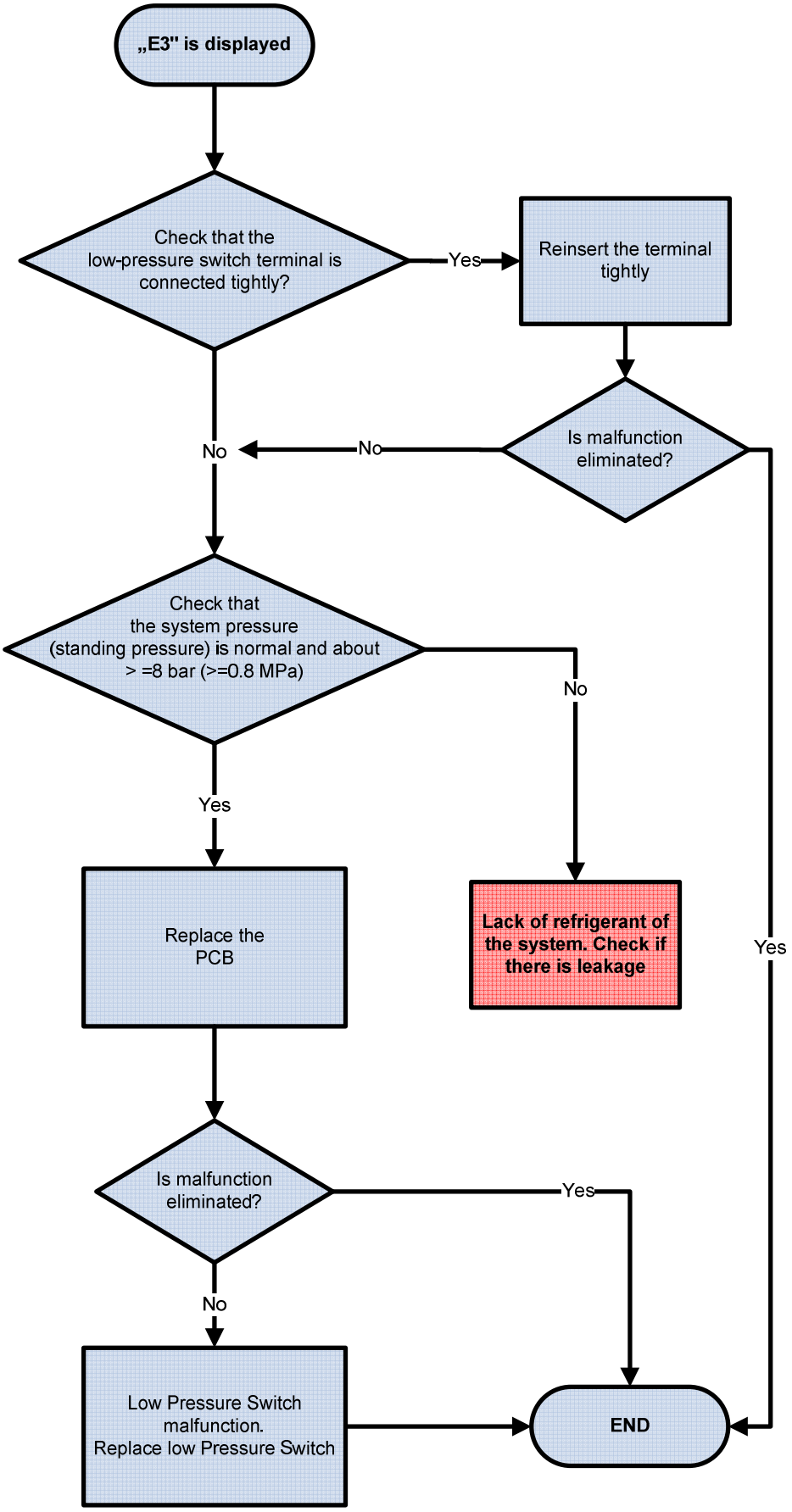
Trouble Shooting for Freeze Protection

According to the below-provided diagram, identify the possible malfunction related to the freeze protection and “E2” error code indication



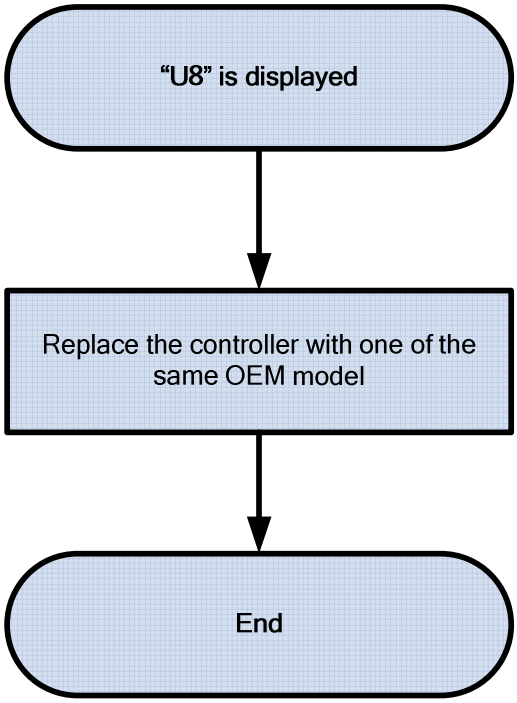
Trouble Shooting for Compressor Low Pressure Protection

According to the below-provided diagram, identify the possible malfunction related to the compressor low pressure protection and “E3” error code indication



Trouble Shooting for PCB

According to the below-provided diagram, identify the possible malfunction related to the controller and “U8” error code indication



Resistance Table of Ambient Temperature Sensor for Indoor and Outdoor Unit

Temp. (℃)	Resistance (kΩ)	Temp. (℃)	Resistance (kΩ)	Temp. (℃)	Resistance (kΩ)	Temp. (℃)	Resistance (kΩ)
-19	138.1	20	18.75	59	3.848	98	1.071
-18	128.6	21	17.93	60	3.711	99	1.039
-17	121.6	22	17.14	61	3.579	100	1.009
-16	115	23	16.39	62	3.454	101	0.98
-15	108.7	24	15.68	63	3.333	102	0.952
-14	102.9	25	15	64	3.217	103	0.925
-13	97.4	26	14.36	65	3.105	104	0.898
-12	92.22	27	13.74	66	2.998	105	0.873
-11	87.35	28	13.16	67	2.896	106	0.848
-10	82.75	29	12.6	68	2.797	107	0.825
-9	78.43	30	12.07	69	2.702	108	0.802
-8	74.35	31	11.57	70	2.611	109	0.779
-7	70.5	32	11.09	71	2.523	110	0.758
-6	66.88	33	10.63	72	2.439	111	0.737
-5	63.46	34	10.2	73	2.358	112	0.717
-4	60.23	35	9.779	74	2.28	113	0.697
-3	57.18	36	9.382	75	2.206	114	0.678
-2	54.31	37	9.003	76	2.133	115	0.66
-1	51.59	38	8.642	77	2.064	116	0.642
0	49.02	39	8.297	78	1.997	117	0.625
1	46.6	40	7.967	79	1.933	118	0.608
2	44.31	41	7.653	80	1.871	119	0.592
3	42.14	42	7.352	81	1.811	120	0.577
4	40.09	43	7.065	82	1.754	121	0.561
5	38.15	44	6.791	83	1.699	122	0.547
6	36.32	45	6.529	84	1.645	123	0.532
7	34.58	46	6.278	85	1.594	124	0.519
8	32.94	47	6.038	86	1.544	125	0.505
9	31.38	48	5.809	87	1.497	126	0.492
10	29.9	49	5.589	88	1.451	127	0.48
11	28.51	50	5.379	89	1.408	128	0.467
12	27.18	51	5.197	90	1.363	129	0.456
13	25.92	52	4.986	91	1.322	130	0.444
14	24.73	53	4.802	92	1.282	131	0.433
15	23.6	54	4.625	93	1.244	132	0.422
16	22.53	55	4.456	94	1.207	133	0.412
17	21.51	56	4.294	95	1.171	134	0.401
18	20.54	57	4.139	96	1.136	135	0.391
19	19.63	58	3.99	97	1.103	136	0.382

Resistance Table of Heat-Exchanger Temperature Sensor for Indoor and Outdoor Unit

Temp. (℃)	Resistance (kΩ)	Temp. (℃)	Resistance (kΩ)	Temp. (℃)	Resistance (kΩ)	Temp. (℃)	Resistance (kΩ)
-19	181.4	20	25.01	59	5.13	98	1.427
-18	171.4	21	23.9	60	4.948	99	1.386
-17	162.1	22	22.85	61	4.773	100	1.346
-16	153.3	23	21.85	62	4.605	101	1.307
-15	145	24	20.9	63	4.443	102	1.269
-14	137.2	25	20	64	4.289	103	1.233
-13	129.9	26	19.14	65	4.14	104	1.198
-12	123	27	18.13	66	3.998	105	1.164
-11	116.5	28	17.55	67	3.861	106	1.131
-10	110.3	29	16.8	68	3.729	107	1.099
-9	104.6	30	16.1	69	3.603	108	1.069
-8	99.13	31	15.43	70	3.481	109	1.039
-7	94	32	14.79	71	3.364	110	1.01
-6	89.17	33	14.18	72	3.252	111	0.983
-5	84.61	34	13.59	73	3.144	112	0.956
-4	80.31	35	13.04	74	3.04	113	0.93
-3	76.24	36	12.51	75	2.94	114	0.904
-2	72.41	37	12	76	2.844	115	0.88
-1	68.79	38	11.52	77	2.752	116	0.856
0	65.37	39	11.06	78	2.663	117	0.833
1	62.13	40	10.62	79	2.577	118	0.811
2	59.08	41	10.2	80	2.495	119	0.77
3	56.19	42	9.803	81	2.415	120	0.769
4	53.46	43	9.42	82	2.339	121	0.746
5	50.87	44	9.054	83	2.265	122	0.729
6	48.42	45	8.705	84	2.194	123	0.71
7	46.11	46	8.37	85	2.125	124	0.692
8	43.92	47	8.051	86	2.059	125	0.674
9	41.84	48	7.745	87	1.996	126	0.658
10	39.87	49	7.453	88	1.934	127	0.64
11	38.01	50	7.173	89	1.875	128	0.623
12	36.24	51	6.905	90	1.818	129	0.607
13	34.57	52	6.648	91	1.736	130	0.592
14	32.98	53	6.403	92	1.71	131	0.577
15	31.47	54	6.167	93	1.658	132	0.563
16	30.04	55	5.942	94	1.609	133	0.549
17	28.68	56	5.726	95	1.561	134	0.535
18	27.39	57	5.519	96	1.515	135	0.521
19	26.17	58	5.32	97	1.47	136	0.509

Resistance Table of Compressor Discharge Temperature Sensor (Outdoor Unit)

Temp. (℃)	Resistance (kΩ)	Temp. (℃)	Resistance (kΩ)	Temp. (℃)	Resistance (kΩ)	Temp. (℃)	Resistance (kΩ)
-29	853.5	10	98	49	18.34	88	4.754
-28	799.8	11	93.42	50	17.65	89	4.609
-27	750	12	89.07	51	16.99	90	4.469
-26	703.8	13	84.95	52	16.36	91	4.334
-25	660.8	14	81.05	53	15.75	92	4.204
-24	620.8	15	77.35	54	15.17	93	4.079
-23	580.6	16	73.83	55	14.62	94	3.958
-22	548.9	17	70.5	56	14.09	95	3.841
-21	516.6	18	67.34	57	13.58	96	3.728
-20	486.5	19	64.33	58	13.09	97	3.619
-19	458.3	20	61.48	59	12.62	98	3.514
-18	432	21	58.77	60	12.17	99	3.413
-17	407.4	22	56.19	61	11.74	100	3.315
-16	384.5	23	53.74	62	11.32	101	3.22
-15	362.9	24	51.41	63	10.93	102	3.129
-14	342.8	25	49.19	64	10.54	103	3.04
-13	323.9	26	47.08	65	10.18	104	2.955
-12	306.2	27	45.07	66	9.827	105	2.872
-11	289.6	28	43.16	67	9.489	106	2.792
-10	274	29	41.34	68	9.165	107	2.715
-9	259.3	30	39.61	69	8.854	108	2.64
-8	245.6	31	37.96	70	8.555	109	2.568
-7	232.6	32	36.38	71	8.268	110	2.498
-6	220.5	33	34.88	72	7.991	111	2.431
-5	209	34	33.45	73	7.726	112	2.365
-4	198.3	35	32.09	74	7.47	113	2.302
-3	199.1	36	30.79	75	7.224	114	2.241
-2	178.5	37	29.54	76	6.998	115	2.182
-1	169.5	38	28.36	77	6.761	116	2.124
0	161	39	27.23	78	6.542	117	2.069
1	153	40	26.15	79	6.331	118	2.015
2	145.4	41	25.11	80	6.129	119	1.963
3	138.3	42	24.13	81	5.933	120	1.912
4	131.5	43	23.19	82	5.746	121	1.863
5	125.1	44	22.29	83	5.565	122	1.816
6	119.1	45	21.43	84	5.39	123	1.77
7	113.4	46	20.6	85	5.222	124	1.725
8	108	47	19.81	86	5.06	125	1.682
9	102.8	48	19.06	87	4.904	126	1.64

Main Spare Parts List

Below OEM parts should be provided only by GREE Electric Company or representatives.

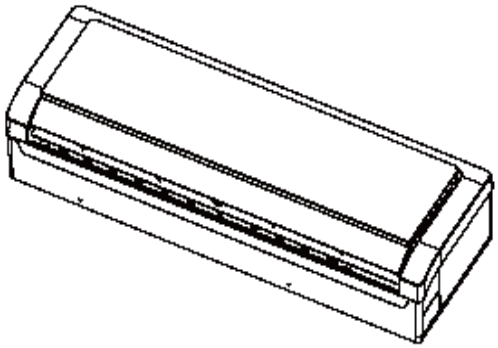
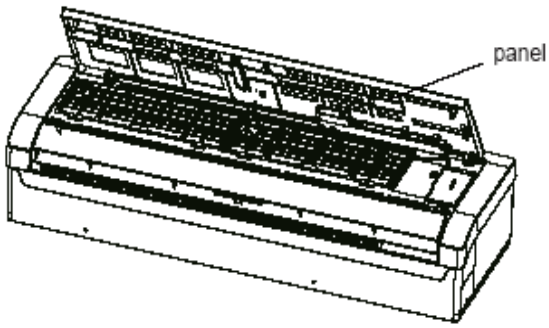
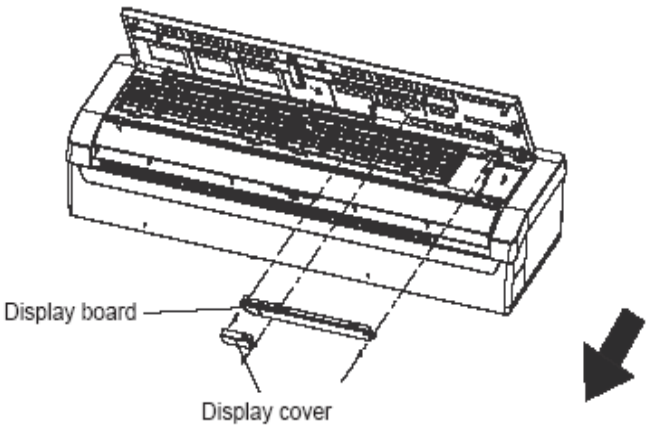
Other spare parts than OEM parts will violate the Air–Conditioner's safety classification and certification status and may keep the unit in a dangerous operational situation!

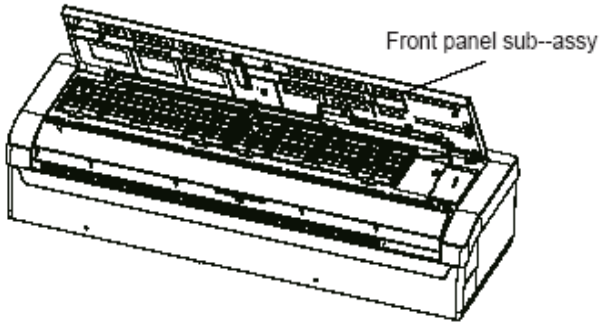
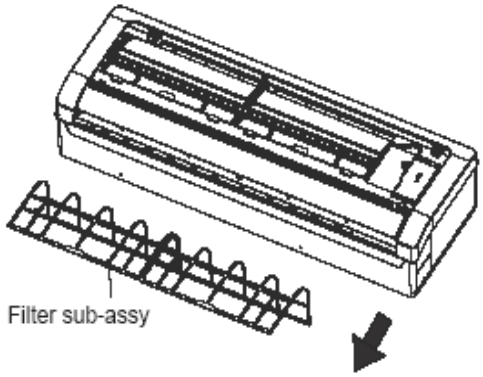
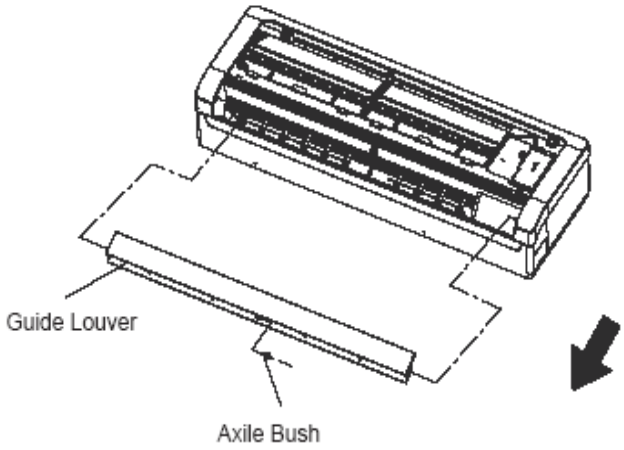
Once you haven't replaced the parts according to the requirement, manufacturer won't bear any responsibility.

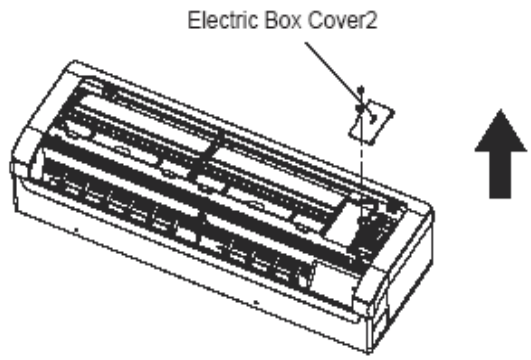
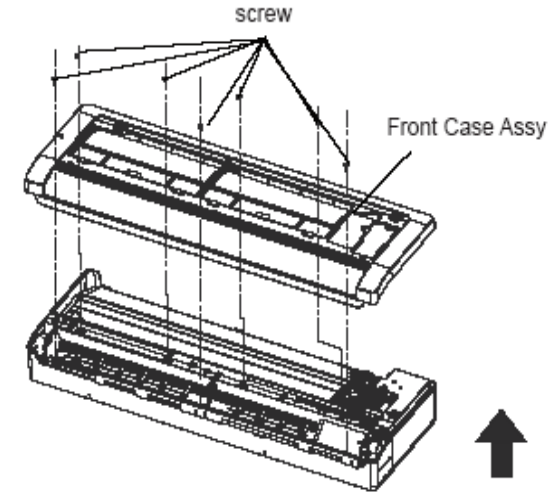
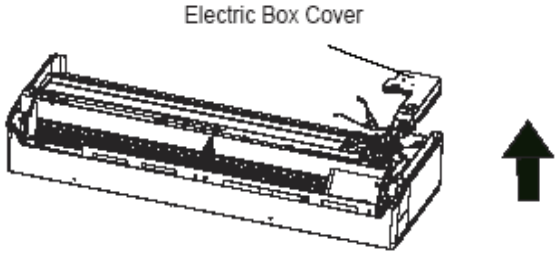
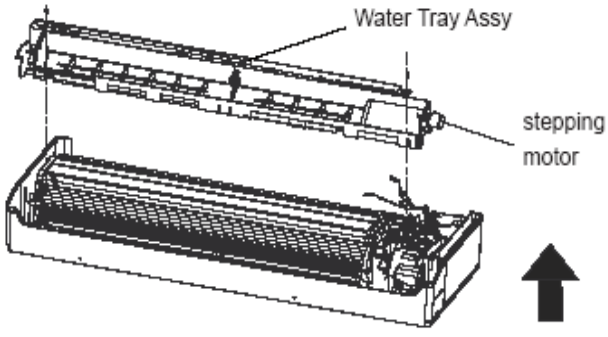
English Name	Model	Bar code	Manufacturer	Grade
Fan Motor(Indoor)	FN10D-PG	1501211503	Zhuhai Kaibang Motor Manufacture CO.LTD.	A
Fan Motor(Outdoor)	FW35D	1501306714	Zhuhai Kaibang Motor Manufacture CO.LTD.	A
Transformer	48X26J	4311026102	Jinmeijia Electronic (Shenzhen) CO. LTD.	A
Main Board	M533F3	30135521	Gree Electric Appliances, INC. of Zhuhai	A
Cross Flow Fan	/	10352422P	Gree Electric Appliances, INC. of Zhuhai	A
Axial Flow Fan	/	10333004P	Gree Electric Appliances, INC. of Zhuhai	A
Low-pressure switch	YK-02L	460200159	Changzhou Changheng Asia-Pacific Electric Appliance Co. ltd	A
Fuse	T3.15AH 250V	46010055	Xiamen Ningly Electronics Co.,Ltd	
Compressor and fittings	QXD-C184A030A	00103146	Zhuhai Lingda Compressor Co.,Ltd	A
Compressor Protector	B210-110-141A	/	Foshan Tongbao Co.,Ltd	A
Sealed box(Relay box)	/	20182144	Gree Electric Appliances, INC. of Zhuhai	A

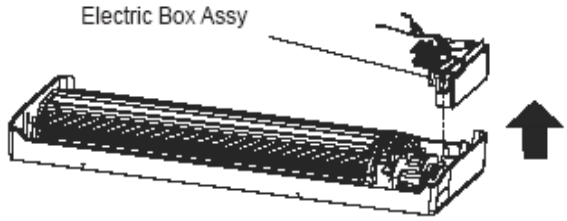
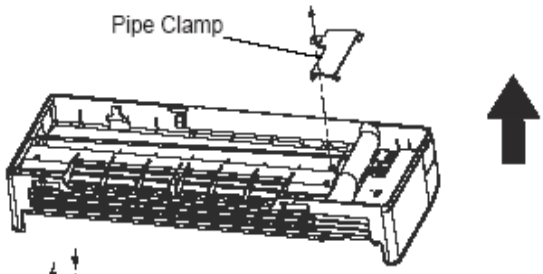
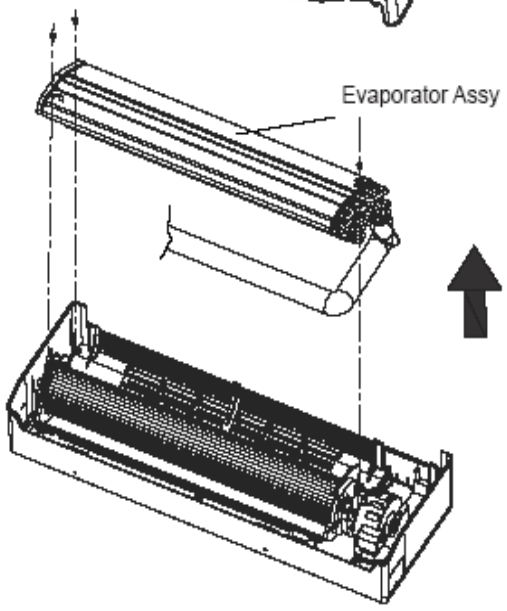
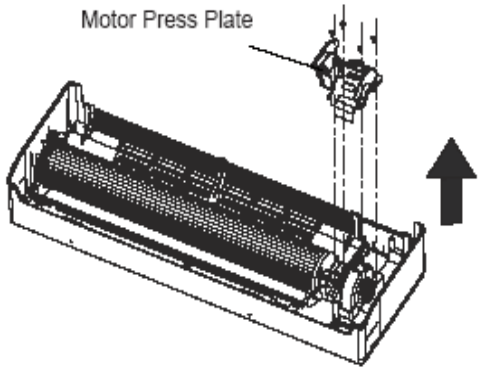
Disassembling Procedures - Indoor Unit

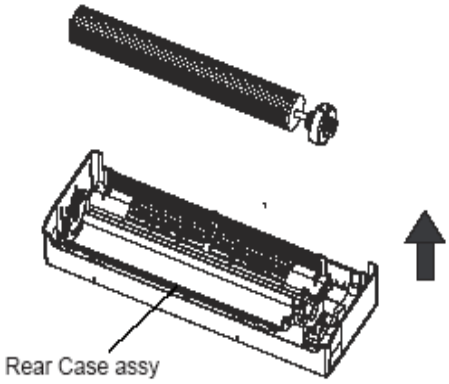
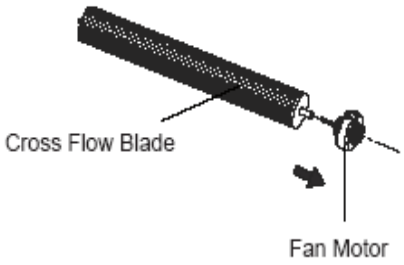
Be sure to wait 10 minutes or more after turning off all power supplies before starting disassembling works!

Step	Procedure	
1. Before disassembling the unit		
2. Remove the displayer		 
1	Open the panel	
2	Twist off the fixing screws used on displayer, displayer box cover 2 and panel and then remove the displayer and displayer box cover 2.	

Step	Procedure
3. Remove panel	
	Open the panel, pull out the panel shaft along the groove used for fixing the panel forcibly and then the panel can be removed.
	
4. Remove filter	
	Loosen the clasps on filter and then remove the filter sub-assy.
	
5. Remove guide louver	
	Loosen the clasps on filter and then remove the filter sub-assy.
	

Step	Procedure
6. Remove electric box cover 2	
Twist off the screws between electric box cover 2 and front case and then remove the electric box cover 2.	
7. Remove front case	
Twist off the 4 screws between the front case and upper part of bottom base with screwdriver, open the screw cap with hand and then twist off the other 3 screws. Loosen the clasps between front case and bottom case with hand and then pull out the front case.	
8. Remove electric box cover	
Loosen the clasps used for connecting the electric box cover and electric box with hand and then remove the electric box cover.	
9. Remove water tray sub-assy	
Twist off the 2 screws used for connecting the water tray sub-assy and bottom case with screwdriver, pull out the plug of stepping motor and then the water tray sub-assy can be removed.	

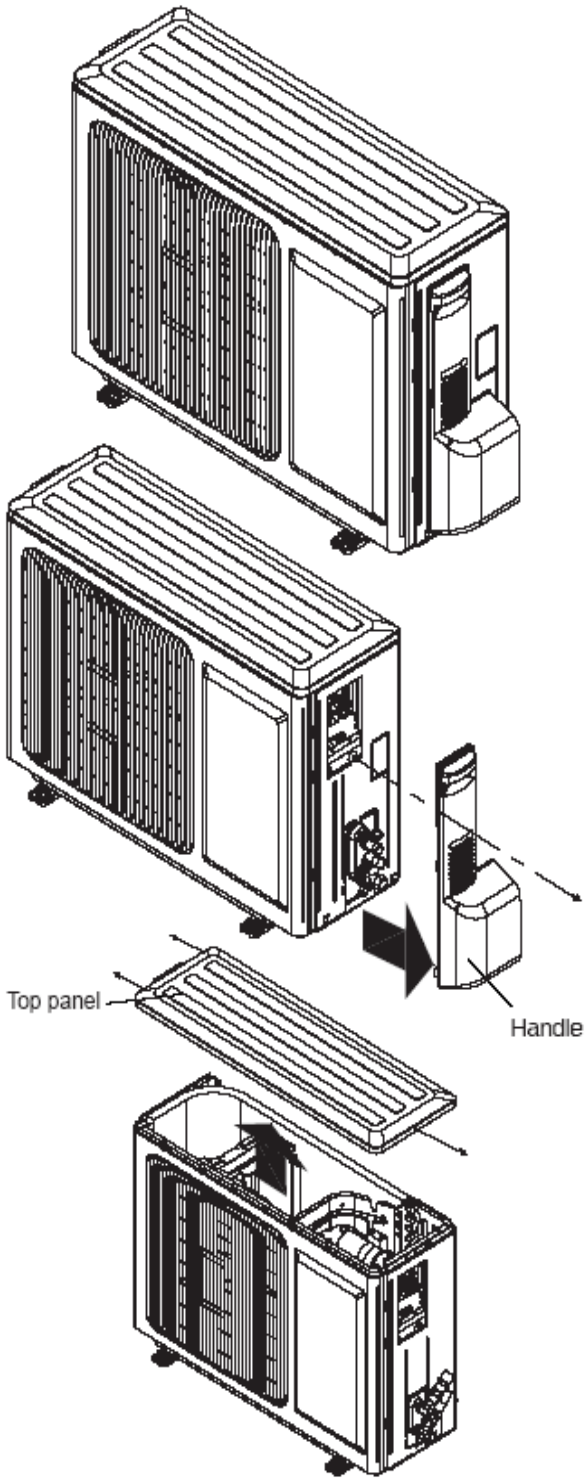
Step	Procedure	
10. Remove electric box sub-assy		
	Twist off the screws used for connecting the electric box sub-assy and bottom case with screwdriver, loosen the clasps, twist off the screws used for connecting the earthing wire and evaporator, pull out the room temperature sensor and then remove the electric box.	
11. Remove evaporator sub-assy		
1	Turn over the bottom case, twist off the screws used for fixing the press board of connection pipe and bottom case with screwdriver, loosen the clasps between press board of connection pipe and bottom case with hand and then remove the press board of connection pipe.	
2	Twist off the connection screws used for connecting the evaporator sub-assy and motor press board and bottom case, loosen the clasps used for fixing the evaporator sub-assy and bottom case and then remove the evaporator sub-assy. Note: please refer to the relevant insutruction in this manual for recovering refrigerant	
12. Remove cross flow blade and motor		
1	Twist off the 4 screws used for connecting the motor press board and bottom case with screwdriver and then remove the motor press board.	

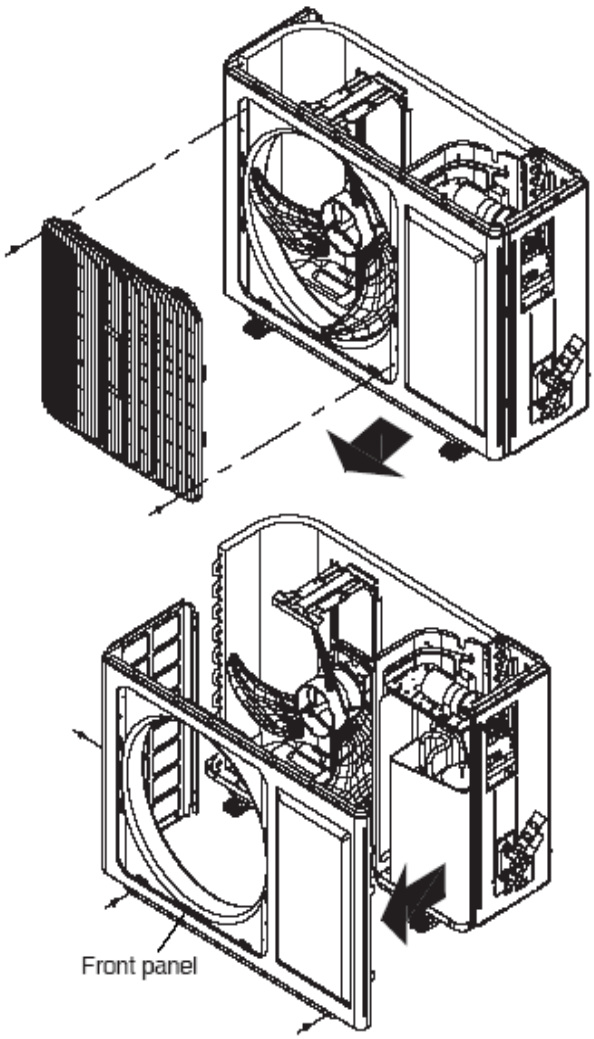
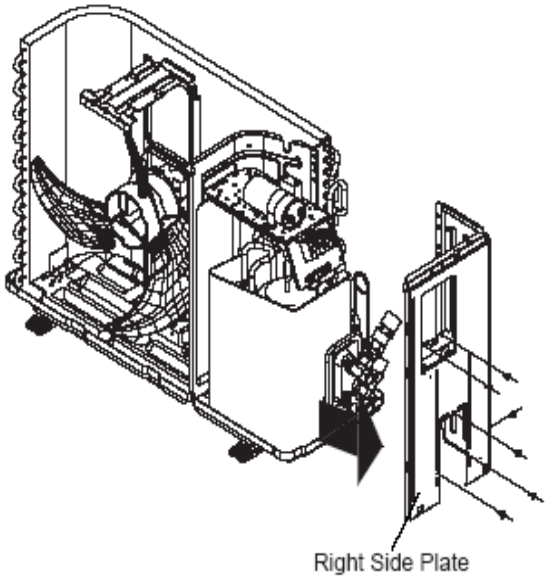
Step	Procedure	
2	Take out the cross flow blade and motor with hands.	
3	Twist off the screws used for fixing the cross flow blade and motor shaft with screwdriver and then remove the motor.	

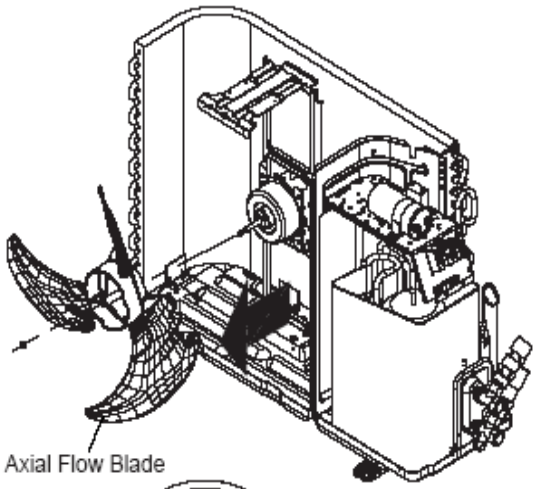
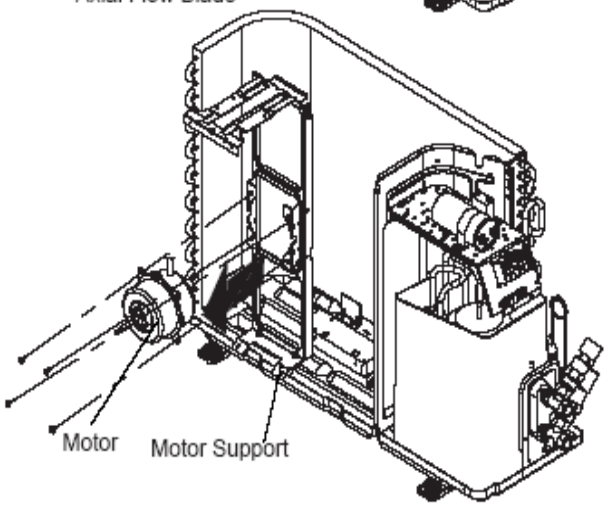
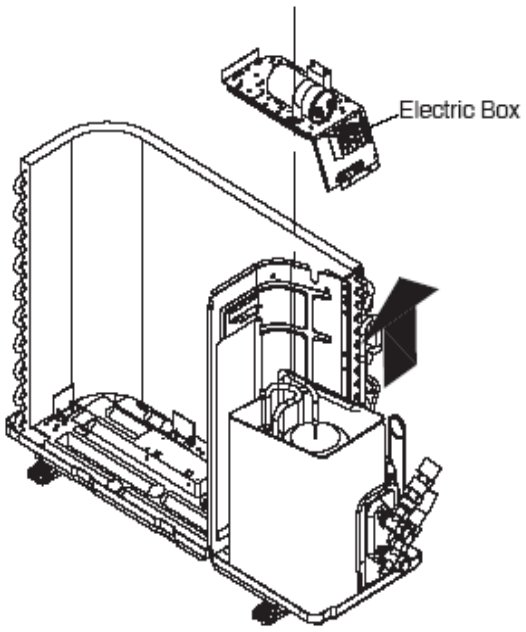
Disassembling Procedures - Outdoor Unit

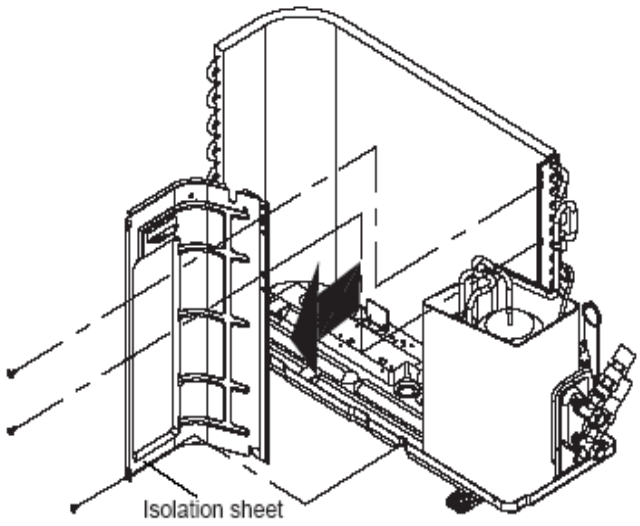
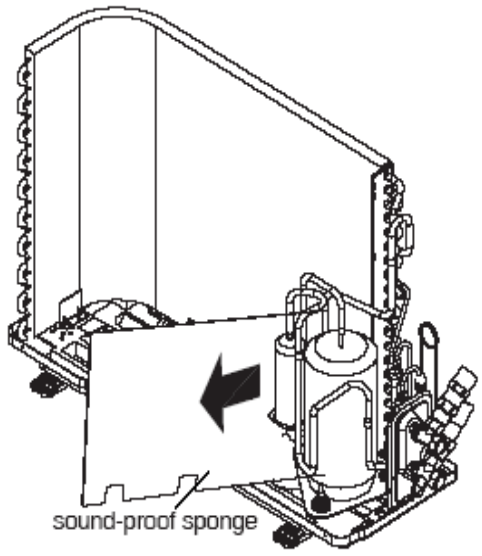
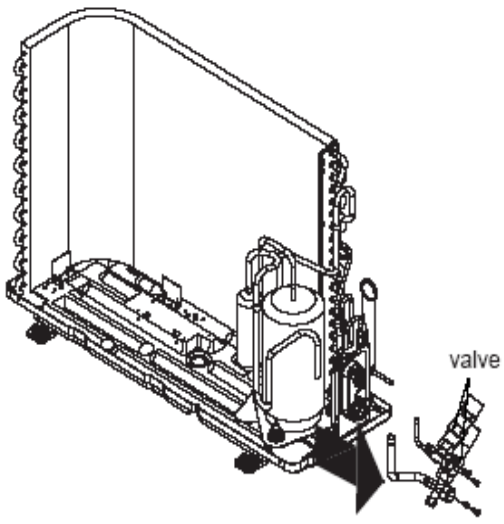
Be sure to wait 10 minutes or more after turning off all power supplies before starting disassembling works!

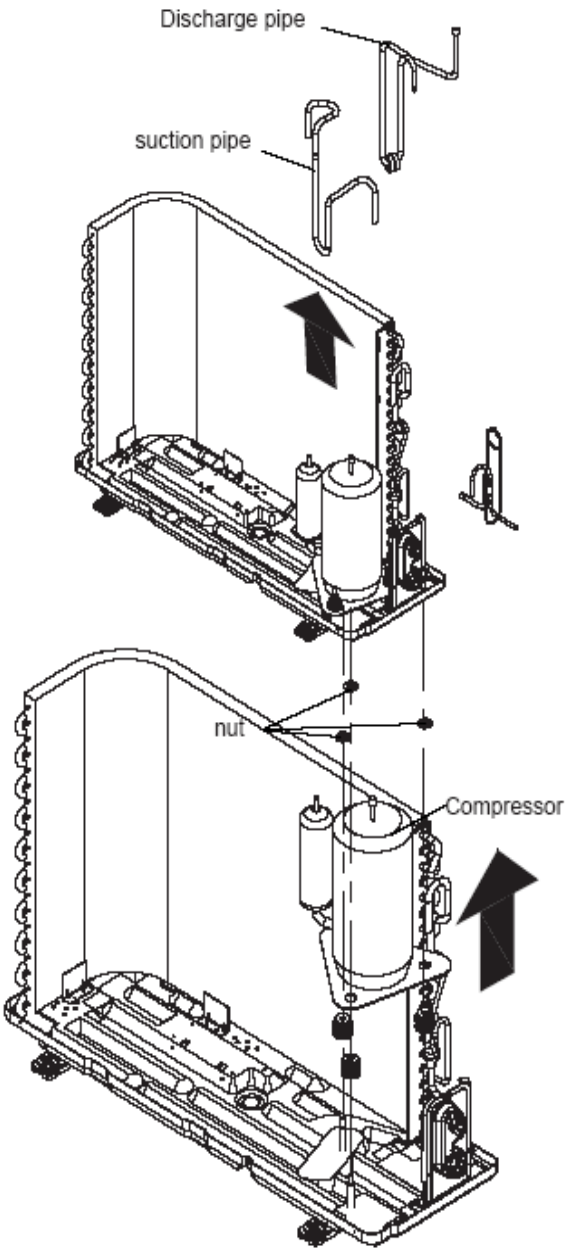
Step	Procedure
1. Remove top cover and handle	
1	Before disassembling the unit.
2	Twist off the screw used for fixing the handle with screwdriver and then remove the big handle.
3	Twist off the 3 screws used for connecting the top cover plate, panel and right side plate, and then remove the top cover plate.



Step	Procedure
2.Remove panel	
1 Twist off the 2 screws used for connecting the grille and panel, loosen the clasps and then remove the grille.	
2 Twist off the 5 screws used for connecting the panel, chassis and motor support with screwdriver and then remove the panel.	
3.Remove right side plate	
Twist off the 6 screws used for connecting the right side plate and chassis, valve support and electric box and then the right side plate can be removed.	

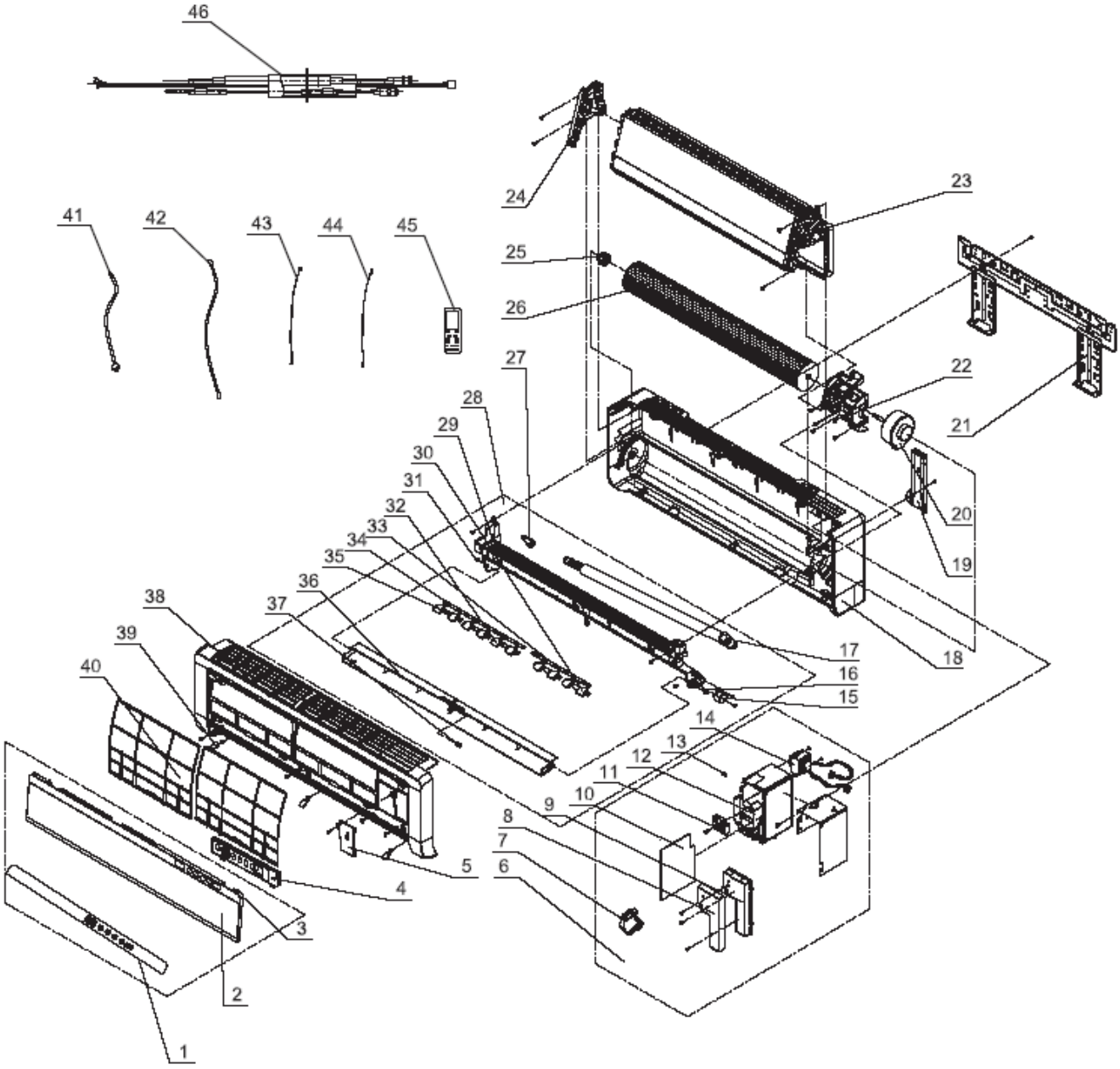
Step	Procedure
4. Remove axial flow blade and motor	
1 Twist off the nuts on blade with wrench and then remove the axial flow blade.	
2 Twist off the 4 tapping screws used for fixing the motor by screwdriver, pull out the pin of leading-out wire for motor and then remove the motor. Twist off the 2 tapping screws used for fixing the motor support, pull it upward and then remove the motor support.	
5. Remove electric box	
Twist off the screws used for fixing the electric box sub-assy with screwdriver, loosen the tieline, pull out the wiring terminal, pull it upward and then the electric box can be removed.	

Step	Procedure	
6. Remove isolation sheet		
1	Twist off the 3 screws used for fixing the isolation sheet with screwdriver and then remove the isolation sheet.	
7.Remove the sound-proof sponge		
	Remove the sound-proof sponge used for wrapping the compressor.	
8.Remove gas valve and liquid valve		
1	Twist off the 2 bolts used for fixing the gas valve, unsolder the soldering joint between gas valve and air-return pipe, and then remove the gas valve. (Note: When unsoldering the soldering joint, wrap the gas valve with wet cloth completely to avoid the damaged to valve due to high temperature). Twist off the 2 bolts used for fixing the liquid valve, unsolder the soldering joint between liquid valve and capillary, and then remove the liquid valve.	

Step	Procedure	
	Caution: **The following procedure can only be performed after the outdoor unit's refrigerant is released and vacuumized it for more than 10mins (please refer to the relevant instruction in this manual for recovering refrigerant)**	
2	Discharge the refrigerant completely; unsolder the pipes connecting the compressor and the condenser assy, and then remove the suction pipe and the discharge pipe.	
3	Unscrew 3 foot nuts of compressor to remove compressor.	

Exploded View of the GREE HC R-290 AC– Split System

Indoor Unit



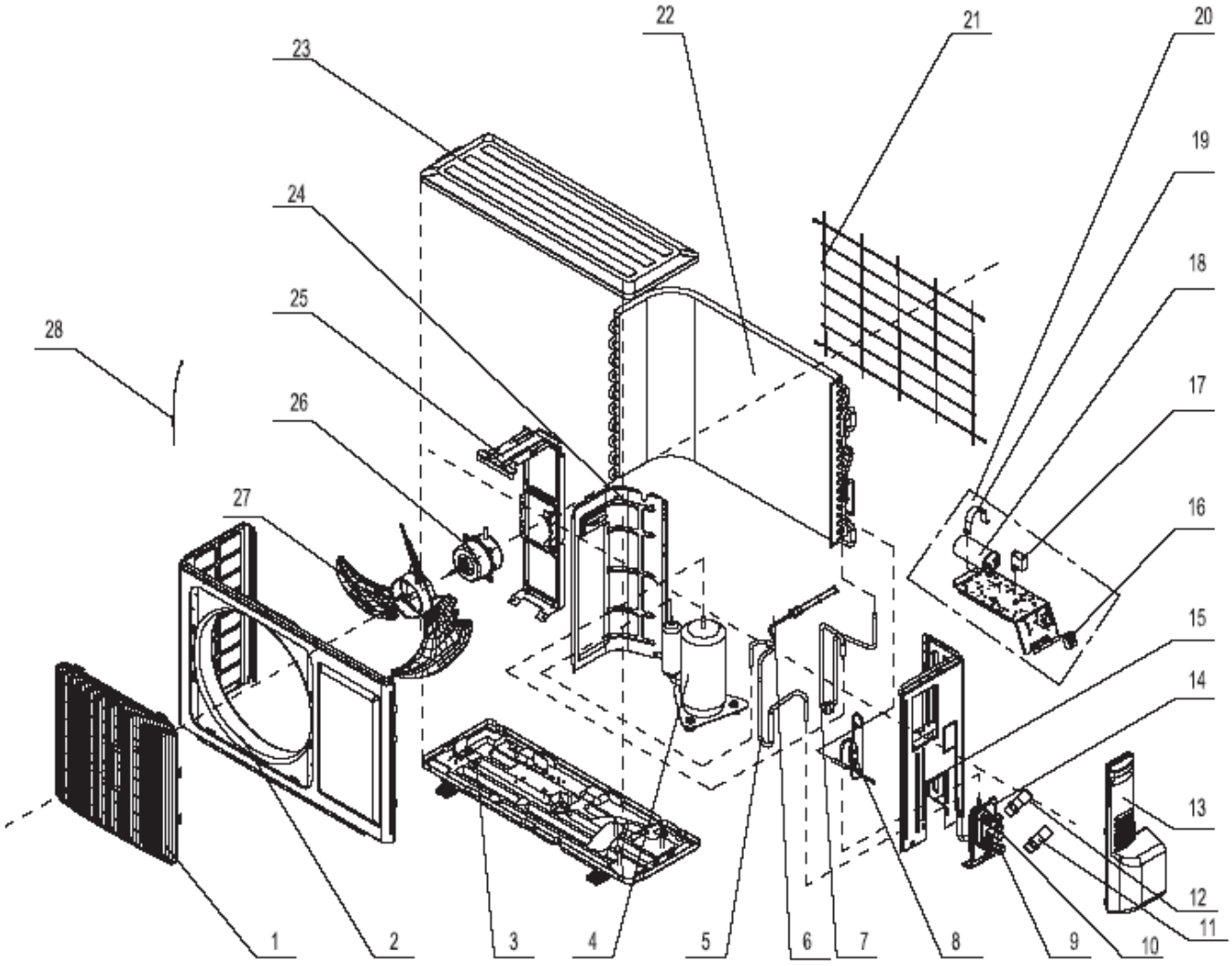
Part List

Indoor Unit

No	Description	Part Code	Qty
		GWC09AA-K5NNA4A/I	
	Product Code	CA115N12800	
1	Decorative Strip	20192184	1
2	Front Panel	20002947	1
3	Front Panel Assy	20012015	1
4	Display Board	30565001	1
5	Electric Box Assy	20202865	1
6	windtight box	20182144	1
7	Shield cover of Electric Box sub-assy	01592101	1
8	Electric Box Cover1	2012210301	1
9	Main Board	30135520	1
10	Terminal Board	4201026801	1
11	Electric Box	20112129	1
12	Jumper	4202300113	1
13	Transformer	4311026102	1
14	Step Motor	15012086	1
15	Crank	10582070	1
16	Drainage hose	0523001401	1
17	Rear Case assy	2220208303	1
18	Pipe Clamp	26112117	1
19	Fan Motor	1501211503	1
20	Wall Mounting Frame	01252006	1
21	Motor Press Plate	26112116	1
22	Evaporator Assy	01002563	1
23	Evaporator Support	24212075	1
24	O-Gasket of Cross Fan Bearing	76512203	1
25	Cross Flow Fan	10352422	1
26	Rubber Plug (Water Tray)	76712012	1
27	Water Tray Assy	20182455	1
28	Water Tray	201820753	1
29	Air Louver(manual)	10512097	2
30	Axile Bush	10542704	1
31	Swing blade (Round hole)	10512099	9
32	Swing lever1	10582071	1
33	Swing lever2	10582072	1
34	Swing Louver Clamp	2611212201	5
35	Guide Louver	10512095	1
36	Axile Bush	10542008	1
37	Front Case Assy	20002746	1
38	Screw Cover	24252017	3
39	Filter Sub-Assy	11122056	2
40	Power Cord	400202818	1
41	Connecting Cable	40030180	1
42	Tube Sensor	390000591	1
43	Ambient Temperature Sensor	390000453	1
44	Remote Controller	305100413	1
45	Quick Connector1	06392003	1
46	Quick Connector2	06392006	1

Exploded View of the GREE HC R-290 AC– Split System

Outdoor Unit



Part List

Outdoor Unit

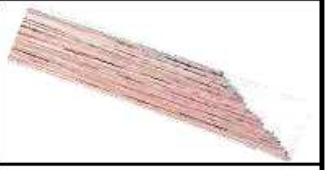
No	Description	Part Code	Qty
		GWC09AA-K5NNA4A/O	
	Product Code	CA115W12800	
1	Front Grill	22413433	1
2	Front Panel	015330124	1
3	Chassis Sub-assy	0120374602P	1
4	Compressor and Fittings	00103146	1
5	Inhalation Tube Sub-assy	03733683	1
6	Pressure Protect Switch	460200159	1
7	Discharge Tube Sub-assy	03733685	1
8	Capillary Sub-assy	03063563	1
9	Valve	07100147	1
10	Valve	07100024	1
11	Quick Connector4	06393012	1
12	Quick Connector1	06393007	1
13	Big Handle	26233433	1
14	Valve Support	01713041	1
15	Right Side Plate Assy	0130200404	1
16	Terminal Board	42011103	2
17	Capacitor CBB61	33010026	1
18	Capacitor CBB65	33000017	1
19	Capacitor Clamp	02143401	1
20	Electric Box Assy	02603657	1
21	Rear Grill	01473057	1
22	Condenser Assy	01163083	1
23	Top Cover Sub-Assy	012532615	1
24	Clapboard Sub-Assy	01233122	1
25	Motor Support Sub-Assy	01703053	1
26	Fan Motor	1501306714	1
27	Axial Flow Fan	10333004	1
28	Temperature Sensor	39000316	1

Recommended Equipment and Tools for Hydrocarbon Refrigerants Servicing

Item	Oblig.	Ideal	Altern.	Description	Pic
1	X			Electronic leak detector for Hydrocarbon refrigerants with flexible probe length of min 30 cm and with audible and visual alarms. Sensitivity less than 50 ppm of Propane, Isobutane and Methane. Response time 5 seconds. Operating temperature: 0°C to 50°C supplied with spare tips and rugged carrying case.	
2		X		Set of "tracer gas leak detector" for the use with tracer gas mixture of 95% N2 and 5% H2. For leaks finding < 1gr/a and conformity with EN35422, EN14624 Complete set with tracer gas detector, pressure regulator, manifold gauge, 2 Litre gas cylinder, service hose and plastic case	
3			X	Set of "tracer gas leak detector" for the use with tracer gas mixture of 95% N2 and 5% H2. For leaks finding < 1gr/a and conformity with EN35422, EN14624, with digital display and leak indentification search mode. Complete set with tracer gas detector, pressure regulator, manifold gauge, 2 Litre gas cylinder, service hose and plastic case	
4	X			Straight refrigerant hose / system quick connector / coupler	
5	X			Elbow refrigerant hose / system quick connector / coupler	
6	X			Sets of 4-valve manifold pressure gauges (3x1/4" and 1x3/8" connections) pulse-free, bar measurement indication, gauges 68 mm with refrigerant scale for HC R-290, R600a and HCFC R-22, including two refrigerant hoses 1/4" SAE - 900mm, one refrigerant hose 1/$" SAE - 1200mm, one 3/8" SAE vacuum hose	

7	X			Digital vacuum gauge, resolution 1 micron. Reads vacuum in 7 units: Micron, PSI, InHg, mbar, Pascal, Torr, mTorr. Cleaning port for cleaning of sensor. Accuracy ± 10 Micron from 100-1000 Micron. Overpressure protected up to 20 bar. Complete set including PE box	
8	X			Two stage rotary vacuum pump; Swept volume minimum 170 L/min (6 CFM); Final partial pressure: 0,020 mbar; Oil level indicator with easy oil change capabilities; Normal and efficient operation in high ambient temperatures and high humidity conditions and to start under vacuum of 5 mbar, 230-1-50/60 power requirement; Hose connection 1/4" and 3/8" SAE and solenoid valve. Pump to be equipped with gas ballast valve (to prevent internal humidity condensation and corrosion) and oil-mist filter with connection 1/2" for refrigerant vent hose. Including 2 liter of spare vacuum pump oil.	
9	X			Electronic charging scale with range of 0 to 5000 gr and 0,5 gr resolution	
10		X		Electronic weighing scale designed for charging and recovery. Capacity 50kg, Resolution 5gr, Accuracy 0,5% of reading, measuring units in kg and lb. Zero function, Battery powered and low-battery indication. Rugged portable case. CE certification.	
11		X		HC refrigerant recovery unit for the use with HC R-600a and R-290. Recovery capacity 32 kg/h; on board storage capacity 250g; equipped with thermal overload and protection and HP switch; 230 V-50Hz- 1Ph	

12		X		Refillable refrigerant recovery cylinder equipped with double valve for liquid and vapour refrigerant transfer. Minimum capacity (water) 11,9 kg (26,2 lbs) Meeting DOT-4BA-400 or ADR P200 standard	
13	X			Set of nitrogen cylinder and pressure regulator DIN EN ISO 2503; Cylinder 5 Litre and 300bar, Regulator pressure 315/200 bar; Working pressure 40 bar; Inlet W24, 32x1/14“ RH; Outlet G1/4“ RH; Adapter for 1/4" NPT refrigerant hose; Nitrogen hose with ball valve and 150cm long	
14	X			Torque wrench tool set in sturdy plastic case; consisting of torque wrench, insertable open-ended wrench in the sizes of 17, 22, 24, 27 and 36.	
15	X			Set of three (3) adjustable wrenches: Size 200mm (8"), size 250mm (10") 250mm, size 300mm (12"). Chrome Vanadium Steel, Chrome Finish	
16	X			Set of seven (7) allen keys; sices 2,5 / 3 / 4 / 5 / 6 / 8 and 10, Chrome Vanadium Steel	
17	X			Set of two (2) tube cutter, tube OD 3 to 16mm and 7 to 41mm, Large tube cutter with Reamer and Spare Wheel	
18	X			Core removal tool, core removal without refrigerant losses, brass with magnetic tip, one 1/4" male flare SAE connection and one female 1/4" connection, equipped with ball-valve	
19	X			Extraction valve for extracting of refrigerants (HCs) out of disposable refrigerant cans, 1/4" SAE refrigerant hose connection	

20		X		Digital-precision quick response thermometer set for thermo-couples and simultaneous connection of two (2) plug-in probes. Display in two, 4 digit LCD. Probe connection in two jacks for flat-pin plugs. Accuracy +/- 1 % (at nominal temperature 25°C. Two (2) K-type probes for measuring range -150°C to 1150°C. Push buttons as membrane keys. Power supply 9V battery.	
21		X		Brazing unit complete: consisting of one 2 liter Oxygen and one 0,425 kg Propane (LPG) gas cylinder. Complete set including valves, safety valves, pressure gauges, constant pressure regulator, 3m hoses, torch and tip sizes 3 according EN962 complete with carying frame.	
22		X		Brazing rods for copper to copper or copper to brass brazing. B-Cu80PAg (L-Ag15P, DIN8513)	
23		X		Brazing flux Cu-Cu, Cu-Brass and Red brass; according to DIN EN 1045	
24		X		Lokring pressing equipment basic set consisting of: Steel case, assembly tool and jaws, Lokprep anaerobic filler, brass connectors, brass reducers, euro flare fittings, Lokring stabilisation inserts	
25			X	HC R-290 refrigerant in disposable cans with charging amount of about 380 gr, purity ≥ 99,5%	
26		X		Hydrocabon R-290 (Propane) refrigerant in cylinder with at least 3 kg charge, purity ≥ 99,5%	

27	X			Protective goggles according to EN 166	
28	X			Protective gloves according to EN 374- Kat.III	
29	X			HC refrigerant venting hose 1/2" with vacuum pump connector and dilutor.	
30	X			Hard-top tool box for electricians consisting of: box size 450x360x190mm, 15 kg; cover-plate and insert pocket; VDE universal pliers 180mm; VDE flat nose pliers 160mm; VDE side cutter pliers 160mm; VDE insulation stripping pliers 160mm; VDE cable knife; cable knife with hook blade; PUK saw; screw drivers set for slotted screws: 2,5x80, 3,5x100, 5,5x125, 6,5x150; Philips screw drivers PH1 and PH2; Pozidriv PZ1 and PZ2; voltage tester (screw driver).	
31	X			Two pin voltage tester (mains tester), Display optic, LEDs, metering capacity - 400V AC/DC, 1.000V AC, IP54	
32	X			Clamp On Ammeter, Digital, 400 A - AC current, Voltage 600 AC, Voltage 600 DC, Resistance 20MOhm, Capacity tester 0-50 µF, LCD, +/-1.8% + 0.6 A AC Current Accuracy, Includes Test Leads, Carrying Case, Battery and Instructions	

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